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Africa Research in Sustainable Intensification for the Next Generation - West Africa

Research in sustainable intensification of cereal-based farming systems in the Guinea-Sudan-Savanna of West Africa

**2015-2016 Work plans**

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The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government’s Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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| --- | --- | --- | --- | --- |
| **Key partners and their roles** | | | | |
| **Name** | **Accronym** | **Ghana** | **Mali** | **Role/responsibility** |
| Afrique Verte, Mali | 1AMASSA |  | + | On-farm and household nutrition studies with ICRISAT. |
| Association Malienne d’Eveil et de Developpement Durable | 1AMEDD |  | + | On-farm field trials and household nutrition studies with ICRISAT. |
| Agricultural Development & Value Chain Enhancement Program | ADVANCE II | + |  | Assist with market linkages, joint demonstration of technologies |
| Animal Research Institute | ARI | + |  | R4D on livestock production (sheep and goats) with ILRI. |
| Agricultural Technology Transfer Project | ATT | + |  | Assist with the introduction of new labor-saving technologies. |
| The World Vegetable Center | AVRDC | + | + | Lead R4D on vegetable production systems. |
| Community-based Organizations | CBOs | + | + | On-farm implementation of R4D activities. |
| International Center for Tropical Agriculture | CIAT | + |  | Lead R4D on land and soil management. |
| Centre d’Appui a l’ Autopromotion pour le Development | 1CAAD |  | + | On-farm groundnut intensification |
| Le Groupe de Recherches d’Actions et d’Assistance pour le Development Communautaire | 1GRAADECOM |  | + | On-farm groundnut intensification |
| Compagnie Malienne de Developpement des Textiles | CMDT |  | + | On-farm field trials and household nutrition studies. |
| Crops Research Institute | CRI | + |  | Breeder seed of improved cereals and legumes. |
| Food Research Institute | FRI | + |  | Household nutrition. |
| Grains and Legumes Development Board | GLDB | + |  | Production of foundation seeds. |
| Heifer International | 1HI | + |  | On-farm livestock production with IITA. |
| World Agroforestry Center | ICRAF |  | + | Lead R4D on agroforestry systems. |
| International Crops Research Institute for the Semi-arid Tropics | ICRISAT | + | + | Sorghum/millet-groundnut R4D with IITA and SARI. |
| International Food Policy Research Institute | IFPRI | + | + | Lead site selection, baseline survey and M&E |
| Institut d’Economie Rurale | IER |  | + | Socio-economic and on-farm studies with ICRISAT. |
| International Institute of Tropical Agriculture | IITA | + | + | Overall project coordination and R4D research on cereal systems |
| International Livestock Research Institute | ILRI | + | + | Lead R4D on ruminants in Ghana and MRMs governance in Mali. |
| Institute for Scientific and Technological Information | INSTI | + |  | Organize training and publish project document with IITA. |
| International Water Management Institute | IWMI | + |  | Lead R4D on water management. |
| Kwame Nkrumah University of Science and Technology | KNUST | + |  | Graduate student training and R4D on rural pig production. |
| Mouvement Biologique du Mali | 1MOBIOM |  | + | On-farm and household nutrition studies with ICRISAT. |
| Ministry of Food and Agriculture | MoFA | + |  | Scaling-out SI technologies and establishment of R4D platforms. |
| Ministry of Health | MoH | + |  | Household nutrition R4D with UDS and IITA. |
| Post-Harvest Losses Innovation Laboratory | PHL-IL | + |  | Joint studies on comparison of grain storage methods and aflatoxin |
| Savanna Agricultural Research Institute | SARI | + |  | R4D on cereal-legume-veg. systems with IITA, ICRISAT and AVRDC. |
| Seed Producers Association of Ghana | 1SEEDPAG | + |  | Production of certified seeds and training on seed production. |
| Small Scale Irrigation Innovation Laboratory | SSI-IL | + |  | Testing of small-scale irrigation options and model validation |
| Soil Research Institute | SRI | + |  | R4D on integrated soil fertility management with IITA. |
| University for Development Studies | UDS | + |  | Graduate training and R4D on rural poultry and pig production. |
| Wageningen University, The Netherlands | WU | + | + | R4D on farming systems characterization and graduate training. |
| 1Non-governmental organization | | | | |

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**Summary**

The 2014-15 work plans are presented separately for Ghana and Mali to ensure clarity and make the document more reader-friendly. The 2013-14 research year work-packages are mapped under five research themes, namely:

1. Partnerships and socio-economics assessment (Research Theme 1, RT1).

2. Intensification of cereal-legume-vegetable cropping (Research Theme 2, RT2).

3. Intensive livestock and integrated crop-livestock production (Research Theme 3, RT3).

4. Land, soil and water management (Research Theme 4, RT4).

5. Improving nutrition, food storage, value addition and mycotoxin management (Research Theme 5, RT5).

Theme 1 is cross-cutting. Farming systems analysis, gender mainstreaming, capacity building and knowledge exchange and dissemination are embedded in all themes. Linkages between activities under each theme are summarized in separate tables for each country.

In line with the recommendations of the mid-term project review during September-October 2014, R4D and innovation platforms will be established and facilitated in both countries to ensure research is demand driven and to support scaling-up. Additionally, the ‘Technology Park’ approach will be adopted in Mali to ensure integration of activities. Publication of research results and better communication among research teams within and across countries will be a major focus.

**1. Introduction**

**1.1 Africa RISING in West Africa**

The project is being implemented in 25 intervention communities in the three northern regions of Ghana (Fig. 1), and 10 villages in the Bougouni-Yanfolila and Koutiala Districts of the Sikasso Region in southern Mali (Fig. 2). It is intended to result in spillover effects to other similar agro-ecological zones in the two countries and beyond.

The implementation strategy, gender awareness and equity issues, scale of operation, knowledge transfer strategies and research hypotheses which contribute to the overall program research and development outputs have been outlined in the 2013-2014 research year work plans. A brief description of the research themes and research questions to be addressed within the theme is given below was outlined in the 2014/15 research year work plans.

**1.2 Research themes**

The work plans are presented under five research themes, and separately for each country for clarity and to make the document reader friendly. The themes are:

1. Partnerships and socio-economics assessment (Research Theme 1, RT1).

2. Intensification of cereal-legume-vegetable cropping (Research Theme 2, RT2).

3. Intensive livestock and integrated crop-livestock production (Research Theme 3, RT3).

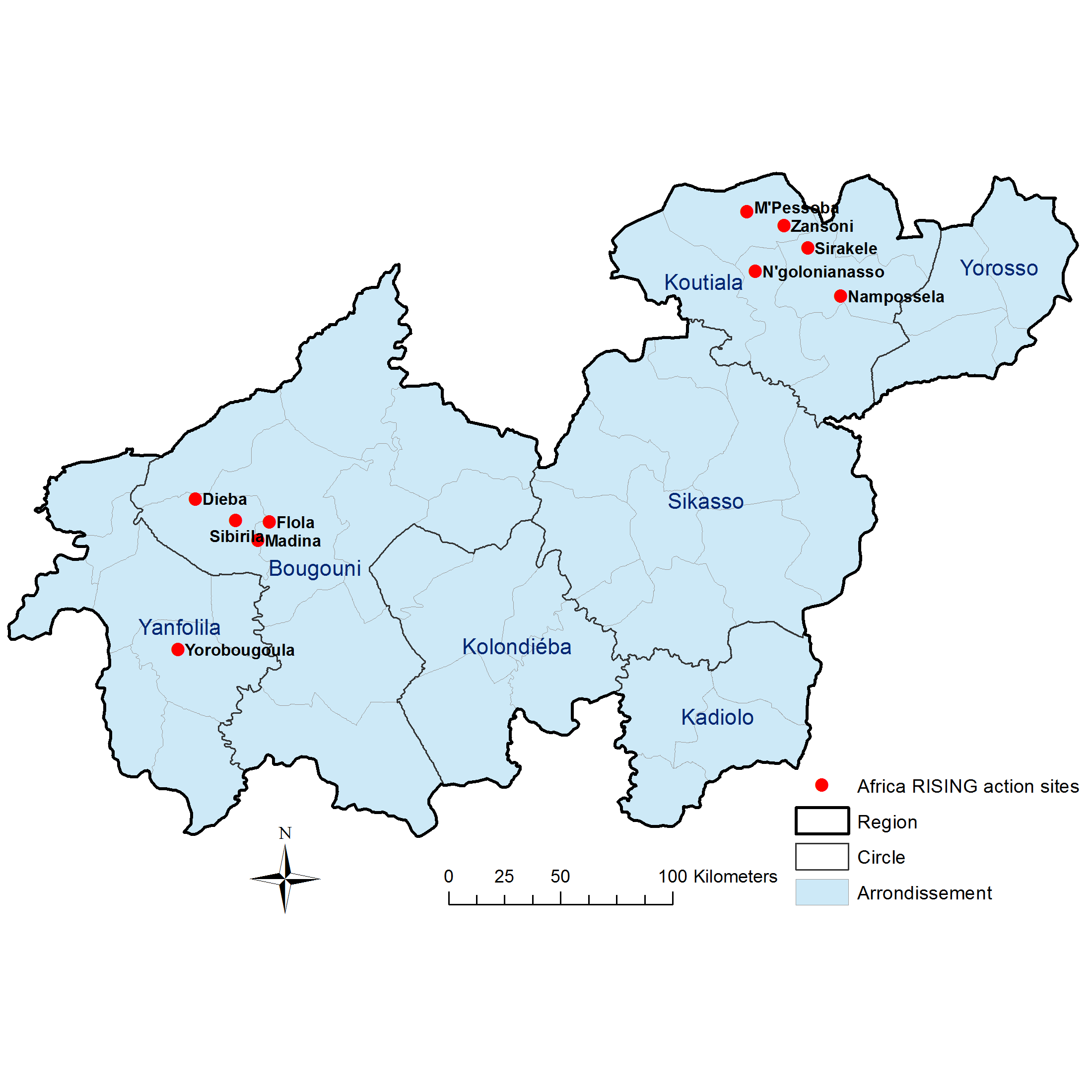
4. Land, soil and water management (Research Theme 4, RT4).

5. Improving nutrition, food storage, value addition and mycotoxin management (Research Theme 5, RT5).

Activities under Theme 1 cut across the other themes. The activities are linked within and across themes to ensure integration. They contribute to the expected outputs of the Africa RISING West Africa project, namely: characterization of the farming systems (Theme 1), increase productivity (Themes 2 and 3), conserve the natural resource base (Theme 4), improve household nutrition and link farmers to markets (Themes 1 and 5), capacity of partners strengthened and knowledge exchange and dissemination improved (Themes 1-5).



Figure 1*.* Africa RISING intervention communities in Ghana.

Figure 2. Africa RISING intervention villages in Mali.

This document presents work plans for the last year of the 5-year project which ends in September 2016. The 2015-16 work plan will therefore focus on data analysis and documentation of results of activities undertaken during the 2012-13, 2013-14 and 2014-15 research years.

**2. Ghana work plan**

**Theme 1: Socio-economics, partnerships and monitoring (RT1-Gh)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Asamoah Larbi | IITA | PhD | Crop-livestock systems | Leader, RT1-Gh-1 |
| Bekele Kuto | IITA | PhD | Agricultural economics | Leader, RT1-Gh-2, 3 |
| Jeroen Groot | WUR | PhD | Farming systems | Leader, RT1-Gh-4 |
| Gundula Fischer | IITA | PhD | Gender/Sociology | Leader, RT1-Gh-3 |
| Mirja Michalscheck | WUR | MSc | Farming systems | PhD student |
| Katrien D | WUR | PhD | Farming systems | RT1-Gh-4 |

|  |  |  |  |
| --- | --- | --- | --- |
| **2. Objectives** | | | |
| 1 | Mobilize communities, revise list of beneficiaries and geo-reference participating households | | |
| 2 | Establish and inaugurate at least 6 district level R4D platforms | | |
| 3 | Conduct a analysis of potential R4D platform actors and their roles | | |
| 4 | Analyze value chains identified by the R4D platforms at the district levels | | |
| 5 | Assess cost and benefit of interventions | | |
| 8 | Create a knowledge sharing and learning framework to facilitate stakeholder interaction | | |
| 10 | Identify and validate different stakeholders and their potential roles in the R4D platforms | | |
| 11 | Assess the adoption of sustainable intensification technologies | | |
|  | | | |
| **3. Activities** | | | |
| **Activity RT1-Gh-1** | | Mobilize communities and facilitate R4D platforms | |
| Lead Scientist(s) | | Asamoah Larbi | Institution: IITA |
| Other scientist(s) | | Mary Asante, Abdul Nurudeen | |
| Consultant | | To be identified | |
| Location(s) | | Intervention communities in Salvelugu, Tolon/Kunbungu, Bongo, Kassena-Nankana, Wa West and Nadowli Districts | |
| **Procedures** | | | |
| *Sub-activity RT1-Gh-1.1: Community mobilization and workshops on 2015 activities* | | | |
| Community consultation initiated in 2015 will continue. Community workshops will be organized to document farmers’ comments on the 2013 participatory trials. The 2014 list of interested farmers will be revised. Households will be tagged or geo-referenced for easy monitoring.  *Sub-activity RT1-Gh-1.2: Facilitation of research for development platforms:* Identification, interviews, validation and recruitment of stakeholders will continue at the district and community levels in all the regions. The R4D platforms in the six districts were launched in 2015. Linkages will be established with the Africa RISING project in the Ethiopian Highlands to assist with the facilitation of the Innovation and R4D platforms. The district level platforms are strategic and broad, but at the community level the IP could follow different value chains or other entry points based on farmers’ interest. | | | |

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| **Deliverables** | | Date (2016) |
| **1** | New stakeholders or actors identified at the community and district levels | June |
| **2** | Facilitation workshop held with Africa RISING Ethipia | May |

|  |  |  |
| --- | --- | --- |
| **Activity RT1-Gh-2** | Economic validation and monitoring adoption of SI options | |
| Lead Scientists(s) | Bekele Kotu | Institution: IITA |
| Other scientist(s) | Stephen Frimpong, Mary Asante, Abdul Nurudeen, David Wawula, Shaibu Bedi, Gundula Fischer, Stephen Frimpong | |
| Location(s) | Intervention communities in Salvelugu, Tolon/Kunbungu, Bongo, Kassena-Nankan, Wa West and Nadowli Districts | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT1-Gh-2.1: Economic validation of improved agricultural technologies.* | | |
| The overall objective of this activity is to complement ongoing biophysical studies in the process of maturing agricultural technologies by assessing their economic advantages. It assesses the profitability of Africa RISING (AR) technologies in Ghana. Three major activities will be conducted under this project for this season. These are the following:  Contribute to publication of results from completed studies: Many trials are on an advanced stage during this year and hence it is high time to look into the data and produce scientific papers. To this effect, we will work together with the scientists responsible for the trials associated with promising technologies. | | |
|  | | |
| *Sub-activity RT1-Gh-2.2: Data collection and analysis of ongoing trials* | | |
| Data collection will continue for additional season for the remaining technologies under bio-physical evaluation based on the data templates developed for this purpose. The data to be collected from the bio-physical trials will constitute, among others, uses of commercial inputs (fertilizer, chemicals, seeds), labor input, draft-power input (oxen or tractor), land characteristics, outputs (grain and non-grain) and physical materials used. These data will be collected for all treatments to be included in the protocol, including the control. Moreover, secondary sources will be explored to collect data on product prices, input prices, wage rates, land use, features of farm lands, demographic characteristics, and maps of different types and scales | | |
|  | | |
| *Sub-activity RT1-Gh-2.3: In-depth socioeconomic assessment of selected technologies:* | | |
| For selected technologies which have won farmers’ preferences, additional assessments will be conducted based on participatory approaches which will involve farmers of different categories (i.e. beneficiary farmers, non-beneficiary farmers, women, youth farmers). In addition to profitability, in this case, we will look into how the proposed technologies fit into existing conditions of farmers (such as labor requirements, cash requirements, social acceptability of technologies, and gender roles). This will generate evidence that can be used to scale up/out the technologies.  Contribute to the analysis and reporting of economic validation of Africa RISING technologies in Mali | | |
|  | | |
| *Sub-activity RT1-Gh-2.4: Monitoring the adoption of Africa RiSiNG technologies:* | | |
| The objective of this study is to assess how well Africa RISING technologies are being adopted by the farmers. This study will depend mainly on a household survey which involves two rounds of data collection. The first round data collection was conducted in August 2015. Data collection will continue during this plan period. Thereafter, the data will be analysed and a report will be prepared. Scientific papers will also be prepared based on the data. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Cleaned datasets | 30 Apr |
| 2 | Report on the status of use of AR technologies | 30 May |
| 3 | MSc thesis on the role of gender in the adoption of sustainable intensification practices in Northern Ghana | 30 Sep |
| 4 | At least two conference papers | 30 Sep |

|  |  |  |
| --- | --- | --- |
| **Activity RT1-Gh-3** | Farming systems analysis and farm re-design | |
| Lead Scientists(s) | Jeroen Groot | Institution: WUR |
| Other scientist(s)  Student(s) | Katrien Descheemaeker, Mirja Michalscheck | |
| Location(s) | Selected communities in the Northern, Upper East and Upper West Regions | |
|  | | |
| **Procedures** | | |
| This activity will identify possibilities to adjust farms and livelihoods of households for sustainable intensification, and to evaluate the impact of implementation on productive, environmental and social performance indicators. It will also inform the households of available options and their impacts, research findings and involve them in research, reflection and learning cycles. This will be closely related to their livelihood strategies.  Collection of additional farm and household information to complement data gathered during rapid characterization and previous community meetings and interviews.  Creating a locally specific ‘basket of technologies’ consisting of potential adjustments to the farms, for instance new crops or animal types, different ways of cultivating crops, managing livestock and manure, surrounding landscape elements, etc. This will be based on entry points previously identified in the participatory community assessments and farming systems analysis.  Participatory and model-based evaluation of the identified options in the basket of technologies. The options will be discussed with farmers, household members, local experts and researchers. They will be evaluated for productive, environmental and social performance indicators in a whole-farm model. In these evaluations there will be emphasis on impacts on household dynamics (including gender balance) and differentiations between various farm/household types and livelihood strategies.  Exploration of tradeoffs and synergies among the productive, environmental and social performance indicators on the basis of the current farm configuration and the available options in the basket of technologies.  All activities will be developed in close consultation and discussion with communities and researchers. There will be explicit attention to the existing heterogeneities in socio-economic and biophysical conditions. | | |

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| **Deliverables** | | Date (2016) |
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|  |  |  |
| --- | --- | --- |
| **Activity RT1-Gh-4** | Gender analysis | |
| Lead Scientists(s) | Gundula Fischer | Institution: IITA |
| Other scientist(s) | Bekele Kotu | |
| Location(s) | Selected communities in the Northern, Upper East and Upper West Regions | |
|  | | |
| **Procedures** | | |
| Gender mainstreaming involving ***strategic*** as well as ***integrated*** gender research activities will be implemented. The strategic research will aim at explicitly exploring gender relations and how they impede or promote equality, the integrated research seeks to include gender aspects in topics such as water management and postharvest technologies.    Strategic gender research will be conducted within the socio-economic project “Monitoring Adoption of Improved Agricultural Technologies in Ghana” which will investigate early stages of adoption, as well as how technologies impact upon gender dynamics within the household and community. A mixed method approach will be used to target both men and women. Data will be gender disaggregated.  Measures will be taken to ensure that activities are more gender-responsive, i.e., taking into consideration disparities such as in labor allocation, access to resources, advisory services and markets.  Gender mainstreaming and analysis will focus on understanding the production constraints men, women and youth face and their preferences of SI innovations (e.g., varieties and technologies, etc.). Specific women-focused activities will include:   * Sensitize partners, farmer groups, and farming households and mainstream gender in farming and decision-making * Assess business opportunities for women and youth in agro-input supply and marketing and value addition * Conduct dissemination campaigns targeting women and young farmers * Develop labor-saving pre- and postharvest tools for female farmers * Build the capacity of implementing partners and stakeholders at community, district and national levels on gender * Capacity strengthening in integrated crop-livestock research to empower women and other disadvantaged groups | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 |  |  |
| 2 |  |  |

|  |  |  |
| --- | --- | --- |
| **Activity RT1-Gh-5** | In-country research management | |
| Lead Scientists(s) | Asamoah Larbi | Institution: IITA |
| Other scientist(s) | Bekele Kotu, Mary Asante, Abdul Nurudeen, Stephen Frimpong | |
| Location(s) | Selected communities in the Northern, Upper East and Upper West Regions | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT1-Gh-5.1: Organize regional research team meetings* | | |
| Regional teams meeting will be organized every 4-8 weeks for local and international partners to discuss problems and share lessons. The meeting will be organized on separate days in each region to allow partners working in more than one region to attend*.* | | |
|  | | |
| *Sub-activity RT1-Gh-5.1: Organize travel exchange visits* | | |
| Exchange visits will be organize for farmers, researchers and extension staff at the community, district and regional levels. This will allow knowledge and information exchange and joint learning among partners. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Regional research team reports | Apr, Jun, Aug, Oct |
| 2 | Report on exchange visits at the community, district and regional level | Aug-Sep |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | Short | Medium | Long |
| 1 | Increased interaction among stakeholders through the R4D platforms | x | x |  |
| 2 | Research institutions use more R4D platforms and less of the linear research-extension approach |  | x | x |
| 3 | Farmers are modifying and adopting technoloties |  | x | x |

|  |  |  |  |
| --- | --- | --- | --- |
| 5. Budget (x 1000 U$) | | | |
| Theme/Activity | Budget Line | IITA | MOFA |
| RT1-Gh-1 | Personnel | 15 | 7 |
|  | Services | 12 | 5 |
|  | Supplies | 8 | 2 |
|  | Travel | 15 | 6 |
|  |  |  |  |
| RT1-Gh-2 | Personnel |  |  |
|  | Services |  |  |
|  | Supplies |  |  |
|  | Travel |  |  |
|  |  |  |  |
| RT1-Gh-3 | Personnel |  |  |
|  | Services |  |  |
|  | Supplies |  |  |
|  | Travel |  |  |
|  |  |  |  |
| RT1-Gh-4 | Personnel |  |  |
|  | Services |  |  |
|  | Supplies |  |  |
|  | Travel |  |  |
|  |  |  |  |
| RT1-Gh-5 | Personnel | 15 |  |
|  | Services | 10 |  |
|  | Supplies | 10 |  |
|  | Travel | 5 |  |
|  |  |  |  |
|  | Total | 90 | 20 |
|  |  |  |  |
|  | Grand total | 110 |  |

**Theme 2: Intensify cropping and integrated crop-livestock systems (RT2-Gh)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Asamoah Larbi | IITA | PhD | Crop-livestock, feeds | Leader, RT2-Gh 1, 2, 3 |
| Saaka Buah | SARI | PhD | Agronomy | Leader, RT2-Gh 2, 3, 4 |
| Jean-Baptiste T | AVRDC | PhD | Vegetable breeding | Leader, RT2-5 |
| Samuel Adjei-Nsiah | IITA | PhD | Agronomy | N2 Africa Country Coordinator |
| Ibrahim Dugje | IITA | PhD | Agronomy | SARD-SC project |
| Atokple IDK | IITA | PhD | Plant Breeding | Cowpea Scaling project |
| Paul Tanzibul | ICRISAT | PhD | Entomology | Groundnut Scaling project |
| Abdul Nurudeen | IITA | PhD | Agronomu | Coordinator, Upper West |
| Mary Asante | IITA | MSc | Agronomy | Coordinator, Upper East |
| Theodore Avukpor | KNUST | BSc | Horticulture | MSc student |
| Mohammed Kadir | KNUST | BSc | Horticulture | MSc student |
| Jonathan Naaba | KNUST | BSc | Horticulture | MSc student |
| Iddrisu Bashiru | KNUST | BSc | Horticulture | MSc student |
| Haruna Abudulai | KNUST | BSc | Horticulture | MSc student |

**2. Objectives**

|  |  |
| --- | --- |
| 1 | Disseminate project results through publication of technical and non-technical papers/leaflets |
| 2 | Test and disseminate cereal-legume-vegetable cropping systems to increase productivity per unit area |
| 3 | Develop and test integrated soil fertility management options to improve crop yields |
| 4 | Improve productivity of irrigated and rainfed vegetable production |
| 5 | Train extension agents, farmers and researchers (MSc and PhD students) |

**3. Activities**

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity RT2-Gh-1** | Intensifying integrated cereal-legume-livestock cropping systems | | |
| Lead Scientists(s) | Asamoah Larbi | Institution: IITA | |
| Other scientist(s) | Abdul Nurudeen, Mary Asante, Peter Asongre, Kotu B, S. Frimpong, | | |
| Student(s) | Haruna Abdullai | | |
| Locations(s) | All intervention communities | | |
|  |  | | |
| **Procedures** |  | | |
|  |  | | |
| *Sub-activity RT2-Gh-1.1: Finilizing trials from Phase 1* | | | |
| Selected ‘Mother’ trials initiated in the Technology Parks during the 2013/14 and 2014/15 research years will be continued for the third year in 3-4 communities per region. Results from completed trials will be analyzed and published as posters and/or papers for publication in international peer reviewed journals. | | | |
|  | | | |
| *Sub-activity RT2-Gh-1.2: Productivity of maize-cowpea strip cropping systems:* | | | |
| On-farm trials have shown cereal (maize) and legumes (groundnut, cowpea, soybean) strip-cropping as one of the farmer preferred promising technologies by the Africa RISING project in Ghana. One of the key objectives of strip cropping is to optimize food and feed production without degrading the soil and water resource basse. The quantity and quality of feed and the management of the residues for mulch and feed in the strip cropping systems were not quantified in the previous studies. Also, early-millet-legume strip cropping systems have not been evaluated. The objectives of the current trials are to:   * Out-scale the cereal legume strip-cropping technology. * Evaluate grain and fodder yields and fodder quality from various cereal-legume strip cropping. * Study residue management for mulch or feed on soil and vegetation properties under strip cropping. * Determine the profitability of various strip cropping systems. | | | |
|  | | | |
| Design and treatments:  A split-plot design with 6-10 replications (farmers will be used) per trial will be established in the NR, UWR and NR. Main plots are two residue management practices and sub-plots are four cropping systems:  Main-plots (residue management)  1. Residue not removed (mulch: soil fertility maintenance)  2. Residuce removed (feeding: livestock)  Sub-plots (cropping systems)  1. Maize alone (M)  2. 1M:1C  3. 2M:2C  4. 2M:4C  Lead farmers with a land area of at least one acre will be identified. Prepare land by preplant application of paraquat to control emerged weeds when rain is fully established. Construct ridges 75 cm apart after land preparation. For the strip cropping, plant cereals and legumes on ridges in the combinations listed above. Participating farmers will be given input (e.g., seeds, fertilizer) and technical support to establish their plots. Sow one maize seed per hill at 75 cm by 25 cm at the recommended density. Apply a basal dose of NPK fertilizer (120:60:60) to both maize and legumes strips about 10-14 days after sowing. Dribble the first dose of N along with all the P2O5 and K2O to maize stands using NPK (15:15:15) within 7 to 10 days after sowing. Dribble the second dose of 50% N/ha using Sulphate of ammonia (12% N) at 4 weeks after sowing. Conduct 2 manual hoe weedings at 2 and 4 weeks after sowing. Spray insecticide only on the legumes 2-3 times during the growing season.  Harvest three 2m x 2m plots to estimate total biomass, grain yield and harvest index. After harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained as mulch for soil fertility maintenance. Sow one maize seed per hill at 75 cm by 25 cm at the recommended density. Apply NPK fertilizer (120:60:60) in two split doses. Dribble the first dose of N along with all the P2O5 and K2O to maize stands using NPK (15:15:15) within 7 to 10 days after sowing. Dribble the second dose of 50% N/ha using Sulphate of ammonia (12% N) at 4 weeks after sowing. Conduct 2 manual hoe weedings at 2 and 4 weeks after sowing.  At harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained for soil fertility improvement. Both, biological (grain and fodder yield, weed biomass and diversity, soil chemical and physical properties) and socio-economic (farmer preferences, labor input, gender distribution of chores) data will be collected.  This activity is implemented in collaboration with the ATT project which will be out-scaling soybean-maize strip cropping at intervention communities outside the Africa RISING intervention communities. | | | |
|  | | | |
| *Sub-activity RT2-Gh-1.3: Productivity of maize-soybean strip cropping systems:* | | | |
| Design and treatments:  A split-plot design with 6-10 replications (farmers will be used) per trial will be established in the NR and UWR. Main plots are two residue management practices and sub-plots are four cropping systems:  Main-plots (residue management)  1. Residue not removed (mulch: soil fertility maintenance)  2. Residuce removed (feeding: livestock)  Sub-plots (cropping systems)  1. Soybean alone (S)  2. 1M:1S  3. 2M:2S  4. 2M:4S  Lead farmers with a land area of at least one acre will be identified. Prepare land by preplant application of paraquat to control emerged weeds when rain is fully established. Construct ridges 75 cm apart after land preparation. For the strip cropping, plant cereals and legumes on ridges in the combinations listed above. Participating farmers will be given input (e.g., seeds, fertilizer) and technical support to establish their plots. Sow one maize seed per hill at 75 cm by 25 cm at the recommended density. Apply a basal dose of NPK fertilizer (120:60:60) to both maize and legumes strips about 10-14 days after sowing. Dribble the first dose of N along with all the P2O5 and K2O to maize stands using NPK (15:15:15) within 7 to 10 days after sowing. Dribble the second dose of 50% N/ha using Sulphate of ammonia (12% N) at 4 weeks after sowing. Conduct 2 manual hoe weedings at 2 and 4 weeks after sowing.    Harvest three 2m x 2m plots to estimate total biomass, grain yield and harvest index. After harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained as mulch for soil fertility maintenance. After harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained for soil fertility improvement. Both, biological (grain and fodder yield, weed biomass and diversity, soil chemical and physical properties) and socio-economic (farmer preferences, labor input, gender distribution of chores) data will be collected.  This activity is implemented in collaboration with the ATT project which will be out-scaling soybean-maize strip cropping at intervention communities outside the Africa RISING intervention communities. | | | |
|  | | | |
| *Sub-activity RT2-Gh-1.4: Productivity of early millet-groundnut strip cropping systems:* | | | |
| Design and treatments:  A split-plot design with 6-10 replications (farmers will be used) per trial will be established in the NR and UWR. Main plots are two residue management practices and sub-plots are four cropping systems:  Main-plots (residue management)  1. Residue not removed (mulch: soil fertility maintenance)  2. Residuce removed (feeding: livestock)  Sub-plots (cropping systems)  1. Early millet (EM)  2. Groundnut (G)  2. 1EM:1G  3. 2EM:2G  4. 2EM:4SG  Lead farmers with a land area of at least one acre will be identified. Prepare land by preplant application of paraquat to control emerged weeds when rain is fully established. Construct ridges 75 cm apart after land preparation. For the strip cropping, plant cereals and legumes on ridges in the combinations listed above. Participating farmers will be given input (e.g., seeds, fertilizer) and technical support to establish their plots. Sow one early millet seed per hill at 75 cm by 25 cm at the recommended density. Apply a basal dose of NPK fertilizer (120:60:60) to both millet and groundnut strips about 10-14 days after sowing. Dribble the first dose of N along with all the P2O5 and K2O to millet stands using NPK (15:15:15) within 7 to 10 days after sowing. Dribble the second dose of 50% N/ha using Sulphate of ammonia (12% N) at 4 weeks after sowing. Conduct 2 manual hoe weedings at 2 and 4 weeks after sowing.    Harvest three 2m x 2m plots to estimate total biomass, grain yield and harvest index. After harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained as mulch for soil fertility maintenance. After harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained for soil fertility improvement. Both, biological (grain and fodder yield, weed biomass and diversity, soil chemical and physical properties) and socio-economic (farmer preferences, labor input, gender distribution of chores) data will be collected.  This activity is implemented in collaboration with the ATT project which will be out-scaling soybean-maize strip cropping at intervention communities outside the Africa RISING intervention communities. | | | |
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| *Sub-activity RT2-Gh-1.5: Sheep stocking density and agronomic practices effects on productivity* | | |
| The objectives of this trial is to evaluate the impact of integrating sheep and goat management and agronomic practices on grain yield and soil chemical, biological and physical properties.  **Design and treatments**  A split-split-plot design replicated in 3-4 communities in the Upper East region is used. Main-plots are two sheep management practices ( no-corralling, corralling with sheep/goats at low and high densities).  1.No corralling  2. Corralling with sheep and goats at low density  3. Corralling with sheep and goats at high density  Sub-plots are three fertilizer rates (government recommended , medium and higher rates of N rates):  1.Government recommended rate (60kg/ha N-40kg/ha P2O5-40kg/ha K2O),  2. Medium rate (90kg/ha N-40kg/ha P2O5-40kg/ha K2O), and  3. Higher rate (120kg/ha N-40kg/ha P2O5-40kg/ha K2O).  Sub-sub-plots are two maize planting densities:  1.Government recommended density (53,333 plants/ha).  2. Higher density (106,666 plants/ha).  Sub-sub plot size will be 4.5m x 5m (6-row plots). Maize will be spaced at 75cm between rows and 40cm within rows. Weed population and density will be evaluated between 2-4 weeks after planting of cereal to determine species diversity and biomass. Grain and fodder yields and soil physical, chemical and biological characteristics will be monitored. | | |
|  | | |
| *Sub-activity RT2-Gh-1.6: Leaf stripping effects on grain and fodder yield* in crop-livestock systems | | |
| Recent studies by SARD-SC has shown that planting maize at double the recommended density and fertilizer rates increases yield and productivity. In an integrated crop-livestock systems, the leaves could be stripped and fed to livestock, but the effects of stripping the leaves on the performance of the maize crop and the soil, water and vegetation resources are not well documented. The objective is to explore the possibilities of adjusting the cropping pattern to produce feed from thinning and leaf stripping.  Design and treatment:  A split-plot design, replicated in 3-4 communities per region will be used. Main-plots will be three leaf stripping methods:  1.No leaf stripping (control)  2. Leaf stripping after 50% of the plants have tasseled,g and  3. Leaf stripping after 50% of the plants have formed cobs.  Sub-plots are factorial combinations of twor maize planting density and nitrogen fertilizer application.  1.Single density (53,333 plants/ha) with single NPK fertilizer (120:60:60)  2. Single density (53,333 plants/ha) with double NPK fertilizer (240:120:120)  3. Double density (106,666 plants/ha) with single NPK fertilizer (120:60:60)  4. Double density (106,666 plants/ha) with double NPK (240:120:120).  The stripped leaves will be used as supplements to tethered piglets and kids. Cost-benefit analysis will be performed. Growth and yield of grain and stover, weed diversity and biomass, quality of the fodder, and weekly live-weight changes in the growing animals fed the fodder will be monitored. Soil moisture and chemical analysis will be monitored. | | |
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| *Sub-activity RT2-Gh-1.7: Cowpea living mulch effects on intensive maize production* | | |
| Soils in the three northern Ghana regions are generally low in fertility, especially organic matter, N, P and K resulting in low grain yields. The living mulch technology has the potential to improve soil physical, chemical and biological status, but there is limited data on its potential in northern Ghana. This study will be conducted in collaboration with the ADVANCE and Scaling Cowpea projects to develop integrated soil fertility management strategies for intensive maize production in the northern and upper west regions.  **Design and treatements**  A split-plot design with cowpea leaving mulch as main-plots and maize planting density as subplots with 4-6 replications.  Main-plots  1. No living mulch  2. Trailing cowpea living mulch  3. Erect cowpea living mulch  Sub-plots  1.Single density (53,333 plants/ha) with single NPK fertilizer (120:60:60)  2. Single density (53,333 plants/ha) with double NPK fertilizer (240:120:120)  3. Double density (106,666 plants/ha) with single NPK fertilizer (120:60:60)  4. Double density (106,666 plants/ha) with double NPK (240:120:120).  Growth and biomass yield of maize and cowpea, weed biomass, surface run-off; soil physical (infiltration rate, porosity, temperature, bulk density), chemical (N, P, K), and biological (micro and macro fauna) properties will be recorded. | | |
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| *Sub-activity RT2-Gh-1.8: Organize a short-course on integrated crop-livestock production* | | |
| Integrated crop-livestock systems predominate in the cereal-legume based farming systems in West Africa. Yet most young researchers, especially women have limited skills in the design and implementation of integrated crop-livestock experiments. A short-course will be organized for young research scientists with training in the crop, livestock and biological sciences. Topics to be covered include integrated crop-livestock systems, design of integrated crop-livestock experiments, and analysis and presentation of data from integrated crop-livestock experiments. | | |

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| Deliverables | | Date (2016) |
| 1 | Revised database on completed IITA trials from 2013-2015 | Aug |
| 2 | At least 4-5 mother trials established in 3-4 technology parks in the regions | Jul |
| 3 | At least 3 papers submitted for publication in impact-factored journals | May-Aug |
| 4 | 2-3 integrated crop-livestock trials to address evaluation team recommendation | May-Jul |
| 5 | A short-course on integrated crop-livestock production organized | Jul-Aug |
| 6 | Graduate students (5MSc and 3 PhD) are co-supervised | Jan-Sep |

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| **Activity RT2-Gh-2** | Test and disseminate improved crop varieties and agronomic practices | |
| Lead scientist(s) | Saaka Buah | IITA, SARI |
| Other scientist(s) | Roger Kanton, Peter Asungre, Julius Yilzagla Francis Kusi, Mumuni Abudulai, Nicholas Denwar, James Kombiok, Issah Sugri, Kenneth Opare-Obuobi | |
| Location(s) | Selected intervention communities in the three regions | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT2-Gh-2.1: Establish database and publish results from completed studies* | | |
| Two years data collected from the following experiments will be used to develop a database. Data will be analyzed and results drafted for publication in peer reviewed journals by the responsible scientists.   1. Responses of extra-early, early and medium maturing maize varieties to fertilizer N in Northern, Upper West and Upper East regions (S.S. Buah, J.M. Kombiok and R.A.L. Kanton) 2. Responses of early and medium maturing soybean to fertilizer and rhizobium inoculation in and Upper West and Northern regions(S.S. Buah and N.N. Denwar) 3. Grain yield of dates of planting and spraying regime on grain and fodder yields of cowpea varieties (Mumuni Abudulai and F. Kusi) 4. Integrated soil fertility management effects on grain and fodder yields and soil chemical and physical properties in soybean-maize rotations in Upper East region (R.A.L. Kanton) 5. Integrated soil fertility management effects on grain and fodder yields and soil chemical and physical properties in cowpea-maize rotations in Upper West region (S.S. Buah) Reducing post-harvest losses in cowpea and maize On-farm trials using 30-50 households per treatment in Northern and Upper East regions (Issah Sugri and M. Abubakari) 6. Potential of round plastic container to reduce post-harvest losses on-farm in Northern and Upper West regions (Issah Sugri and M. Abubakari) 7. Testing of sorghum hybrids trials for identification of yield potential in Upper East region in Northern, Upper West and Upper East regions (K. Opare-Obuobi, S.S. Buah and R.A.L. Kanton) 8. Evaluation and adaptation of millet varieties in Upper East region of Ghana using the Participatory Variety Selection method (Peter A. Asungre) 9. Response of improved rice crop (Gbewaa) to different Nitrogen levels in the Upper East Region (Julius Yirzagla). 10. Participatory evaluation of 8 varieties each of Okra and Roselle using IPM strategies in the Upper East region (Francis Kusi). | | |
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| *Sub-activity RT2-Gh-2.2: Effect of nitrogen fertilizer rates on rice*. | | |
| As with the 2015 cropping season, on-farm trials will be established in Bonia, Nyangua and Samaboligo in the Upper East region (UER) to assess the agronomic and economic benefits of using varying rates of fertilizer N (0, 30, 60, 90 and 120 kg N/ha) on two rice varieties (Gbewaa an farmer variety) during the 2016 cropping season using the Mother and baby variety evaluation approach.Interested households will be selected and given seed and fertilizer. Grain yield and farmer preference will be recorded. | | |
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| *Sub-activity RT2-Gh-2.3: Early millet-cowpea strip cropping intensification among farmers in Upper East region of Ghana.* | | |
| Two improved varieties of cowpea (legume) and one of early millet (cereal) will be used in a strip cropping with the early rains. The cereal and legume will be sown in the following row combinations: 2 cereals: 2 legumes; 3 cereals: 3 legumes; 4 cereals: 4 legumes. Participating farmers will be given input (e.g., seeds, fertilizer) and technical support to establish their plots. A basal dose of 100kg/ha NPK (15:15:15) will be given followed by a selective application of 20kg/ha N only on cereal rows and two sprays of insecticide only on the legumes. RCBD with three or four replications, depending on land availability, will be used with plot size of 6.0m x 5m (30m2) and between rows spacing of 0.75m. The intra-row spacing will be 0.20m for both millet and cowpea. Three seeds of each crop will be sown and thinned to two plants per stand two weeks after sowing. At harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained for soil fertility improvement. Both, biological (grain and fodder yield) and socio-economic (farmer preferred cowpea variety and strip cropping systems, labour input, gender distribution of chores) data will be collected. | | |

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| *Sub-sub-activity RT2-Gh-2.4: Maize-soybean rotation:* |
| An on-station maize-soybean rotation trial to evaluate the response of soybean to organic, mineral and *Rhizobium* inoculants started in 2013 and will continue. Treatments are: 1) soybean (no soil amendment), 2) soybean + inoculant, 3) soybean + inoculant + 60kg/ha P2O5, 4) soybean + inoculant + fertisol, 5) soybean + inoculant + fertisol + 60kg/ha P2O5), 6) soybean + inoculant + 25-60-30kg/ha as N, P2O5, and K2O, 7) continuous maize and 8) continuous soybean. The design is a randomized block with four replications. Plot size will be 4.5m x 5m (6-row plots). Soybean will be spaced 75cm x 5cm and maize at 75cm x40 cm. |
|  |
| *Sub-sub-activity RT2-Gh-2:5 Maize-cowpea rotations* |
| An on-station maize-cowpea rotation trial to evaluate the response of soybean to organic and mineral fertilizer and *Rhizobium* inoculant started in 2013 and will continue. Treatments are: 1) cowpea alone (no soil amendment), 2) cowpea + inoculant, 3) cowpea + inoculant + 60kg/ha P2O5, 4) cowpea + inoculant + fertisol, 5) cowpea + inoculant + fertisol + 60kg/ha P2O5/ha), 6) cowpea + inoculant + 25-60-30kg/ha as N, P2O5, and K2O, 7) continuous maize and 8) continuous cowpea. The design will be a randomized block with four replications. Plot size will be 4.5m x 5m (6-row plots). Cowpea will be spaced 60cm x 10cm and maize at 75cm x 40cm. Plant height, days to flowering, pods per plant, grain and stover yields, harvest index and soil chemical properties, pests and diseases will be monitored in all trials. |

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| **Deliverables** | | Date (2016) |
| **1** | At least 6-8 papers submitted for publication | Dec |
| **2** | Agronomic packages for cereal-legume production identified | Dec |
| **1** | Best agronomic practices and farmer preferred rice variety for rice production | Sep |

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| **Activity RT2-Gh-3** | Intensification of rainfed and irrigated vegetable production systems | |
| Lead Scientist(s) | Jean-Baptiste Tignegre | Institution: AVRDC |
| Other scientist(s) | Richard Boateng, Alpha Sidy Traore, Larbi Asamoah, A.Nurudeen,,Francis Kusi, IssahSugri, Salim Lamini | |
| Student(s) | Theodore Eyram Avukpor, Mohammed Abdul Kadir, Jonathan Naaba, Iddrisu Bashiru | |
| Location(s) | Three selected communities in each region | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT2-Gh-3.1: Improving productivity of dry season vegetable cropping systems* | | |
| Best practice hubs will be established in selected communities to evaluate and demonstrate production of pure stands (mono-crops) of vegetables under irrigation during the dry season using the ‘mother-baby-trial’ approach. Treatments to be considered will include: vegetable species and/or varieties, agronomic practices (mulch and no-mulch, planting density, fertilizer rates, pest management), and irrigation systems (hand watering from wells, sprinkle and drip irrigation). | | |
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| *Sub-activity RT2-Gh-3.2: Improving productivity of rainy season vegetable cropping systems.* | | |
| As above, participatory testing will be carried out to assess the suitability of selected high value, multiple disease-resistant and nutrient-dense vegetable cultivars for cultivation under mixed cropping regimes with cereals (maize, sorghum, millet) and/or legumes (cowpea, pigeon pea, soybean). All trials will include sole vegetable and cereal plots to serve as checks to assess the performance of the vegetables in the integrated systems. The data on the two years-trials on improving productivity of dry season vegetable cropping systems will be analysed; a manuscript will be submitted in a peer reviewed journal for publication | | |
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| *Sub-activity RT2-Gh-3.3*: *Hands-on training on best production practices and post-harvest handling.* | | |
| It is proposed to cluster demonstration and training activities around best practices hubs to be set-up in each of two regions (Northern and Upper East) each connecting to target communities in each of two districts per region. Farmers (households) will be trained, local seed actors/enterprises and extension staff’s knowledge reinforced in intensive vegetable production, integration of vegetables into cereal-legume production systems, community based seed production and storage, post-harvest management. Field days and exchange visits (possibly to neighboring countries) will be used to (a) raise awareness on vegetable-enriched food preparations that preserve or enhance nutritional content, particularly for women and children, (b) raise awareness on exotic and little-known vegetables and legumes and (c), expose farmers to simple postharvest handling options that reduce losses and optimize returns in the market. | | |

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| **Deliverables** | | Date (2016) |
| **1** | Two papers submitted for publication in peer reviewed journals | June |
| **2** | Four MSc students defend their dissertation | August |

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| **4. Expected outcomes** | | Short | Medium | Long |
| 1 | More households are integrating legumes into cropping systems | x | x |  |
| 2 | Households adopt cereal-legume rotations and intercropping |  | x | x |
| 3 | More households are integrating vegetables into their cropping systems |  | x | x |
| 4 | Farmers are adopting improved agronomic practices | x | x | x |

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| **5. Budget (x1000 U$)** | | | | | |
| Theme/Activity | Budget Line | IITA | AVRDC | SARI | MOFA |
| RT2-Gh-1 | Personnel | 125 |  |  |  |
|  | Services | 50 |  |  | 2 |
|  | Supplies | 50 |  |  | 3 |
|  | Travel | 25 |  |  | 10 |
|  |  |  |  |  |  |
| RT2-Gh-2 | Personnel |  |  | 24 |  |
|  | Services |  |  | 12 |  |
|  | Supplies |  |  | 18 |  |
|  | Travel |  |  | 6 |  |
|  |  |  |  |  |  |
| RT2-Gh-3 | Personnel |  | 40 |  |  |
|  | Services |  | 20 |  |  |
|  | Supplies |  | 30 |  |  |
|  | Travel |  | 10 |  |  |
|  |  |  |  |  |  |
|  | Total | 250 | 100 | 60 | 15 |
|  |  |  |  |  |  |
|  | Grand total | 425 |  |  |  |

**Theme 3: Intensive livestock production (RT3-Gh)**

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| **1. Research team** |  |  |  |  |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Augustine Ayantunde | ILRI | PhD | Feeds, animal husbandry | Leader, RT3-Gh-1 |
| Tunde Amole | ILRI | PhD | Feeds, animal husbandry | RT3-Gh-1 |
| Franklin Avornyo | ARI | PhD | Feeds, animal husbandry | RT3-Gh-1 |
| Asamoah Larbi | IITA | PhD | Crop-livestock production | Leader, RT3-Gh-2-6 |
| Michael Boateng | KNUST | PhD | Monogastric nutrition | RT3-Gh-2 |
| Terry Ansah | UDS | MSc | Ruminant nutrition | RT3-Gh-4-5 |
| Addah Weseh | UDS | PhD | Feeds, animal husbandry | RT3-Gh-1 |
| Henry Alagma | UDS | BSc | Ruminant nutrition | MSc student |
| Mary Awuni | UDS | BSc | Monogastric nutrition | MSc student |
| Daniel Apalibe | UDS | BSc | Monogastric nutrition | MSc student |
| Goodman Safo | KNUST | MSc | Monogastric nutrition | PhD student |
| Amponsah Bright | KNUST | BSc | Pig production | MSc student |
| Raphael Ayizanga | KNUST | MSc | Animal breeding | PhD student |
| Solomon Kolan | UDS | MSc | Nutrient cycling | PhD student |

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| **2. Objectives** | |
| 1 | Test feed/health options to improve productivity and nutrient cycling in sheep/goat production |
| 3 | Evaluate options to increase productivity of rural poultry production |
| 4 | Evaluate options to improve productivity of rural pig production |
| 5 | Test and disseminate options to increase crop and livestock outputs from fallow lands |
| 6 | Test and disseminate agronomic strategies to optimize feed from cereal-legume cropping systems |
| 7 | Identify high-yield and better quality cereal and legume crop genotypes for food and feed |
| 8 | Improve capacity of extension staff, researchers and farmers in integrated-livestock production |

**3. Activities**

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| **Activity RT3-Gh-1** | Feed and health interventions for improved small ruminant production | |
| Lead Scientist(s) | Augustine Ayantunde | Institution: ILRI |
| Other scientist(s) | Franklin Avornyo, Addah Weseh, Sadat Salifu, Tunde Omole | |
| Graduate students | Solomon Kolan | |
| Location(s) | Botingli, Tibali, Duko (Northern Region), Gia, Nangua (Upper East Region), Guo, Zanko (Upper West Region) | |
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| **Procedures** | | |
| *Sub-activity RT3-Gh-1.1: Feed and health interventions for improved small ruminant production in Ghana* | | |
| It has been demonstrated that simple interventions involving disease control, improved nutrition and better management lead to marked positive effects on small ruminant performance and productivity. Building on activities conducted in 2012 and 2013, feed and health interventions will be carried out in 9 communities involving 3 treatments (Treatment 1 = health intervention: vaccination against PPR (Peste de petits ruminants, goat plague) and Pasteurellosis and deworming using Ivermectin; Treatment 2= health intervention as above and supplementary feeding of balanced rations) and a control (Treatment 3 = no health and no feed intervention). The health interventions will be administered by officials of the Ministry of Food and Agriculture in each region. One village will be selected in each region for each treatment making three villages per region. All small ruminants (sheep and goats) in the six villages (2 villages per region) with health interventions will be vaccinated against PPR and Pasteurellosis, and will be dewormed. The feed interventions will be applied to 10 households in one village per region. Participating farmers will be provided with necessary feed ingredients and will be trained in mixing the ingredients to be used as supplement for their animals. In all the nine villages to be selected for the study, 10 households will be selected for monitoring of their flocks based on their willingness and ownership of at least 6 sheep and 6 goats. All sheep and goats in these households will be ear-tagged and weighed monthly. Manure produced will be collected and weighed monthly. A research assistant will be based in each village for the monitoring of the flock dynamics of the selected households in terms of entries (birth, purchase, animal received as gift or on loan) and exits (death, sales, and slaughter for household consumption, animal given out as gift or loan). MOFA will be responsible for the application of the health intervention including vaccination of the sheep and goats in the 9 intervention communities. The experimental farmers will be trained in mixing the feed rations for their animals. Cost-benefit analyses will be conducted to assess the profitability of feed and health interventions. The 3 treatments explained above will be applied at a village level because of the nature of the treatments (in particular the health intervention). The villages in the same region (3) will be considered as a ‘block’ given that they are close enough and matched enough (on agro-ecological and socio-economic profile). The villages will be RANDOMLY allocated to one of the 3 treatments. Mixed effect models will be used for ANOVA for any response variable with Region effect (2 degrees of freedom), Treatment effect (2 d.f.) and 4 d.f. for the residual and each treatment has 3 replications / villages. Gender differentiation in management of the household sheep and goat flocks will be documented as well as decision making process in animal offtake.  Data collection on feed-health interventions will continue in all the nine intervention communities till August 2016 to complete one year data. The training of the experimental farmers in mixing feed rations will also continue. A manual on improved small ruminant production targeted at smallholder farmers and extension workers will be produced. | | |
|  | | |
| *Sub-activity RT3-Gh-1.2: Building capacity of smallholders in small ruminant production in Ghana:* | | |
| Workshops will be organized to train farmers on many aspects of small ruminant production including disease control, feed formulation, better animal management practices and marketing. For building the capacity of the local communities in disease control, key members of livestock farmers’ associations will be trained in each community by the veterinarians from Ministry of Food and Agriculture in diagnosis of common small ruminant diseases, record keeping and in providing preliminary treatments subject to the national law for the operations of Community-based Animal Health Workers. The training of the Community Animal Health Workers will continue in the intervention communities. The community members to be trained will also be responsible for providing timely situation report to the veterinary services at the district level. Training of farmers has been conducted on conservation of cassava peels, ground nut haulm and rice straw in the 9 intervention communities. Farmers were trained through practical technical demonstrations on methods of ensiling groundnut haulms and cassava peels and urea-treatment of rice straw for feeding ruminants in the dry and cropping seasons in Northern Ghana. In addition to the training of the farmers, it is necessary to assess animal performance as a result of the conservation techniques for improved crop residue management. The plan is to conduct empirical assessment of the effects of the crop residue conservation technologies introduced to the farmers on the growth performance (average daily gain) of their animal. Data to be collected will include nutritional quality of the conserved forages and the effects of supplementing these conserved agro by-products on feed intake and growth performance of sheep and goats. Data will be analyzed with breed, sex and initial weight as random variables in the model. The study will be conducted in two intervention communities per region. These will include Botingle and Tingoli (Northern region), Zanko and Guo (Upper West), and Nyangua and Gia (Upper East). A graduate (MSc student) student from University of Development Studies will be put on the project for data collection. | | |
|  | | |
| *Sub-activity RT3-Gh-1.3: Nutrient flows in small ruminant production systems in Ghana:* | | |
| Quantifying the nutrient use in smallholder livestock production systems is essential to balancing nutrients supplied in feeds to animals’ requirements, leading to improved livestock production, and consequently whole farm productivity and economic profitability. Also this is important to identify options or strategies for better nutrient management in the systems thereby reducing waste and loss. Eight out of the 20 households to be selected under sub-activity 1.1 will be selected in the three communities in each of the three regions on the criteria of integration of crop and livestock systems, and willingness to participate in a long term study. The households will be monitored over 24 months to address seasonal variations in nutrient use. Feeding practices of the selected households will be monitored as well as manure production of the household flocks. Feed and fecal samples will be collected for laboratory analysis to determine nutrient inflows and outflows in the systems. This activity will be carried out along with the activity on improving small ruminant production. Two years data collection on nutrient flows in small ruminant production systems in the project intervention communities has been completed. The focus of this sub-activity will be on data analysis and preparation of draft manuscript. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report and a draft manuscript on improved small ruminant production | Aug |
| 2 | Manual on improved small ruminant production for smallholder farmers and extension workers | Jul |
| 3 | Report on conservation of crop residues for improved small ruminant productivity | Jul |
| 4 | Database on nutiritional quality of feed resources in Northern Ghana | Jun |

|  |  |  |
| --- | --- | --- |
| **Activity RT3-Gh-2** | Evaluate and disseminate options to intensify rural poultry and pig production | |
| Lead Scientist(s) | Herbert Die, Ben Alenyorege | Institution: UDS/KNUST/IITA |
| Other Scientist(s) | Asamoah Larbi, Michael Boateng | |
| Student(s) | Goodman Safo-Kantaka, Daniel Apalibe, Raphael Ayizanga | |
| Location(s) | Tibali, Duko, Botingli, Tibognayili, Cheyohi (Northern Region), Samboligo, Bonia, Nangua(Upper East Region), Zanko, Guo, Passe, Goli, Nato-Douri (Upper West Region) | |
|  | | |
| **Procedures** | | |
| Sub-activity RT3-Gh-2.1: Organize expert consultation on livestock research | | |
| Livestock related activities in the project has been implemented under the leadership of ILRI (sheep and goats), UDS (poultry) and KNUST (pigs).The IITA and USAID commissioned evaluation teams found that livestock research related activities were limited. Both recommended more livestock activities, especially activities related to sheep and goat and poultry production. Over the past 4 years, the Animal Production Division and the Veterinary Services Division of the Ministry of Food and Agriculture, as well as the private sector have played limited roles in the implementation of the livestock activities.  The objective of this activity is to organize a 2-day meeting of the relevant partners to identify researchable livestock activities for joint implementation. | | |
|  | | |
| *Sub-activity RT3-Gh-2.2: Publish survey report as a booklet:* | | |
| A survey of rural poultry production systems in the intervention communities was completed in 2013. The report will be edited and published as a booklet. | | |
|  | | |
| *Sub-activity RT3-Gh-2.3: Develop, evaluate and disseminate improved technologies to intensify poultry production*: | | |
| The survey in 2013 identified lack of enabling institutions and policies, poor market access, lack of improved breeding, inappropriate husbandry (housing, feeding, breeding and health care) practices, as well as lack of information/knowledge as key constraints to rural poultry production. In 2015, farmer participatory research will be conducted to test a combination of housing, feeding and health packages to address the constraints. The exact packages to be tested will be determined from consultations with farmers and the R4D Platforms. Most likely, combinations will be to test the traditional systems of management (control) and improved management (housing, health-care and feeding) using a randomized complete block design with districts as blocks. Data to be collected will include matured live-weight, duration to maturity, mortality, duration of brooding, number of eggs, production costs, income, quantity of manure and profit over a period of 40 days. Trials will be conducted on both domestic chicken and guinea fowls. | | |
|  | | |
| *Sub-activity RT3-Gh-2.4: Develop, evaluate and disseminate technologies to intensify rural pig production:* | | |
| In 2015, farmer participatory approaches will be used to develop, evaluate and disseminate a combination of housing, feeding, breeding and health care options to improve and intensify rural pig production. The exact packages to be tested will be determined from consultations with farmers and the R4D Platforms. These may likely include trials on: comparison of extensive versus intensive management; effect of supplementation in performance of grower and finisher pigs under the free range management system; a survey to document green forage species fed to pigs, and the performance of growing pigs supplemented with different levels of concentrates; development and testing of breeding strategies to reduce inbreeding, meat processing and linking farmers to markets. In all trials, feed intake, body weight gain, feed conversion efficiency, mature live-weight, mortality rate, production costs and net profit will be recorded. The impact of the improved technologies on household income will be assessed. | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | Short | Medium | Long |
| 1 | More households keep their livestock under intensive management | x | x | x |
| 2 | Households have improved manure management |  | x | x |
| 3 | Farmers are adopting lamb fattening to capture niche markets |  | x | x |
| 4 | Village committees are managing fallow lands |  | x | x |
| 5 | Households are producing more feed from cropping systems | x | x |  |
| 6 | National researchers are implementing more integrated crop-livestock activities | x | x | x |
|  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **5. Budget (x 1000 U$)** | | | | | | | |
| Theme/Activity | Budget Line | IITA | ILRI | ARI | UDS | KNUST | MOFA |
| RT3-Gh-1 | Personnel |  | 72 |  |  |  |  |
|  | Services |  | 36 |  |  |  |  |
|  | Supplies |  | 44 |  |  |  |  |
|  | Travel |  | 18 |  |  |  |  |
|  |  |  |  |  |  |  |  |
| RT3-Gh-2 | Personnel | 4 |  |  | 9 | 10.5 | 10.5 |
|  | Services | 6 |  |  | 6 | 7 | 7 |
|  | Supplies | 2 |  |  | 12 | 14 | 14 |
|  | Travel | 3 |  |  | 3 | 3.5 | 3.5 |
|  |  |  |  |  |  |  |  |
|  | Total | 15 | 170 |  | 30 | 35 | 35 |
|  |  |  |  |  |  |  |  |
|  | Grand total | 285 |  |  |  |  |  |

**Theme 4: Land, soil and water management (RT4-Gh)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Davie Kadyampakeni | IWMI | PhD | Soil and water | Leader, RT4-Gh-2 |
| Fred Kizito | CIAT | PhD | Soils, water & landscapes | Leader, RT4-Gh-1 |
| Eliasu Salifu | CIAT | MSc | Soil Water Management | Research assistant |
| Kennedy Nganga | CIAT | BSc | GIS/Remote Sensing | Mapping and field work |
| Pamela Katic | IWMI | PhD | Economics | Market links |
| Terry Ansah | UDS | PhD | Ruminant nutrtion | Forage quality analysis |
| Wilson Agyare | KNUST | PhD | Soil, crops, agronomy | Trials on RT4-GH1-4 |
| Francis Tetteh | SRI | PhD | Soil, crops, agronomy | Soil science |
| Emmanuel Panyan | ARI | PhD | Soil, crops, agronomy | Agronomic expertise |
| Rockyfeller Achulivor | KNUST | BSc | Soil and water | Graduate student |

**2. Objectives**

The main objective in this work-package is to improve water management practices for crop-livestock production systems of northern Ghana. Specifically, this component will:

|  |  |
| --- | --- |
| 1 | Test small-scale irrigation technologies for dry season vegetable production |
| 2 | Test water management practices to improve productivity in rainfed crop-livestock systems |
| 3 | Prepare and disseminate knowledge materials to end users |
| 4 | Evaluate options to improve land and soil management |
| 5 | Draft and submit 2-3 journal papers |
| 6 | Monitor, implement and demonstrate best-bet on-farm soil and land conservation interventions for improved soil and nutrient retention. |
| 7 | Provide farmer recommendation and conduct trade-off analysis and scenario generation for soil and land restoration strategies that highlight associated economics of land degradation and restoration management. |

**3. Activities**

|  |  |  |
| --- | --- | --- |
| **Activity RT4-Gh-1** | Testing small-scale irrigation options for dry season vegetable[[1]](#footnote-1) production | |
| Lead Scientist(s) | Davie Kadyampakeni | Institution: IWMI |
| Other Scientist(s) | Pamela Katic | |
| Location(s) | Duko, Samboligo, Bonia, Nyangua in the Northern and Upper East Regions | |
| Other Partners | Asamoah Larbi, Jean-Baptiste Tignegre, Wilson Agyare | |
|  | | |
| **Procedures** | | |
| Irrigation management is critical for sustainable crop production particularly in the dry season. The following sub-activities will be implemented and will be linked to the ILSSI project in one of the selected sites. | | |
|  | | |
| *Sub-activity RT4-Gh-1.1.* *Site/Watershed characterization*: | | |
| This will involve delineation of the selected watershed and sites, documenting long-term rainfall trends, quantifying of surface and groundwater resources and other biophysical elements of relevance to irrigation. | | |
|  | | |
| Sub-activity RT4-Gh-1.2: *Dry spell analysis of selected catchments in Northern and Upper East Ghana:* | | |
| This subactivity will include the analysis of long-term rainfall trends on data collected for the past 30 to 50 years in cereal (maize, sorghum and millet) and legume (cowpea, soy bean) cropping system. The dry spell analyses, a follow-up to biophysical watershed characterization done in 2015/2016 will be supported with simulations of cropping scenarios under supplementary irrigated or entirely rainfed conditions to provide guidelines for supplementary irrigation. | | |
|  | | |
| *Sub-activity**RT4-Gh-1.3. Participatory evaluation of water lifting and water delivery methods for vegetable production:* | | |
| Various water lifting and conveyance technologies will be compared with regards to water productivity, labor and cost requirements for the dry season vegetable production. The following water lifting and delivery technologies will be implemented:   * Water lifting technologies: i) motorized pumps, ii) solar pumps, iii) water cans/buckets * Water application methods: i) drip, ii) furrow, iii) overhead tank with a hose, iv) bucket irrigation | | |
|  | | |
| *Sub-activity RT4-Gh-1.4. Assessment of irrigation frequency and amount using different irrigation scheduling methods:* | | |
| A simple tool (sensor-based) will be tested to assist farmers in the irrigation scheduling of vegetables. The tool indicates when the root-zone is dry and when it becomes saturated during irrigation. The water productivity and overall irrigation application rates using the sensors will be compared against: i) a fixed irrigation schedule and ii) the farmers’ normal practice. The assessment on farmers’ fields will include appropriate nutrient and pest management practices and it will provide an opportunity for farmers to compare the tested irrigation scheduling methods with respect to water, labor and time savings. This will also provide the framework for farmers to judiciously optimize irrigation management in water scarce environments. | | |
|  | | |
| *Sub-activity RT4-Gh-1.5. Socio-economic analysis of water management interventions for dry season vegetable production:* | | |
| The interventions listed in the sub-activities RT4-Gh-1.2 and RT4-Gh.1.3above will be analyzed in terms of adoption potential, labor productivity, costs and benefits, business models for successful interventions and market potential for produced vegetables. Special attention will be given to understanding the adoption potential, constraints and benefits to men, women and youth in the farming communities. | | |

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| --- | --- | --- |
|  | Deliverables | Date (2016) |
| 1 | A report on socio-economic of water management technologies | Jul |
| 2 | Journal manuscript on water management submitted | Aug |
| 3 | Conduct farmer exchange visits | May |

|  |  |  |
| --- | --- | --- |
| **Activity RT4-Gh-2** | Improving water productivity in rainfed crop-livestock production system | |
| Lead scientist(s) | Davie Kadyampakeni | Institution: IWMI |
| Other scientist(s) | Pamela Katic | |
| Location(s) | Upper East and Upper West Regions project sites | |
| Other Partners | Emmanuel Panyan, Wilson Agyare | |
|  |  | |
| **Procedures** | | |
| The rainfed crop-livestock production system requires demonstration of effective water management interventions to enhance productivity. In particular, forage production is often affected by rainfall irregularities and is actually scarce during the dry season. This activity component will explore with farmers, the potential for adopting irrigated forage production in Ghana. The following sub-activities will be implemented. | | |
| *Sub-activity RT4-Gh-2.1: Exploring the potential for forage irrigation in Northern Ghana:* | | |
| The potential for forage production through irrigation in northern Ghana would be investigated through literature review and questionnaire surveys. It will cover the: 1) potential for adoption of forage irrigation by male and female farmers and 2) market opportunities for forage and the added value of forage irrigation to the livestock value chain during the dry season. | | |
|  | | |
| *Sub-activity RT4-Gh-2.2: Piloting supplementary irrigation for forage production:* | | |
| Under supplementary irrigation, forage crops will be produced and differentiated for different types of fodder crops, leguminous vs. non-leguminous fodder. About 5 to 15 farmers will be identified to pilot the production of folder under supplementary irrigation. | | |
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|  | Deliverables | Date (2016) |
| 1 | Technical report and guidelines on irrigated fodder production | Apr |
| 2 | Installation of fodder production plots and farmer training in Upper East Ghana | Aug |

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| --- | --- | --- |
| **Activity RT4-Gh-3** | Piloting improved combinations of soil and land management strategies on-farm | |
| Lead Scientist(s) | Fred Kizito | Institution: CIAT |
| Other scientist(s) | Davie Kadyampakeni, Wilson Agyare, Francis Tetteh, Kennedy Nganga Panyan | |
| Location (s) | Bonia, Nangua, Gia (Upper East Region) | |
|  | | |
| **Procedures** | | |
| In order to provide viable interventions and recommendations, we propose piloting of on-farm trials to address erosion prevalence and land degradation that will in turn increase crop productivity through three sub-activities outlined below | | |
|  | | |
| *Sub-activity RT4-Gh-3.1: Re-inforce and maintain established on-farm land and soil conservation structures*:- | | |
| This will entail maintenance of established tied-ridges, cover crops, and contour cropping compared against farmer practices. | | |
|  | | |
| *Sub-activity RT4-Gh-3.2: Monitor soil losses, nutrient movements and soil moisture variation*. | | |
| To provide evidence for sub-activity 1.1;  Soil losses will be monitored by a modified version of runoff soil loss detectors that captures 75% of the plot runoff zone; the dimensions of the runoff detectors are 1 m x 0.15 m x 0.15 m.  Nutrient dynamics will be monitored using suction lysimeters which will be held at a tension of 70 cbars and installed at varying depths along the profiles of interest in order to ascertain fate and transport as well as verify what percentage is captured within the crop root zone;  Soil moisture will provide vital links to both soil and nutrient losses. Soil moisture will be monitored using a diviner probe (Sentenk Inc.) to depths of 1.0 m at 10 cm increments within the profile. Access tubes for moisture measurement with the diviner probe will be installed in the center position of the target plots. | | |
|  | | |
| *Sub-activity RT4-Gh-3.3: Evaluate effectiveness of land and soil conservation structures towards mitigating soil losses, nutrient losses and soil moisture conservation*. | | |
| This will entail conducting a detailed analysis of the spatial and temporal trends of the data collected through monitoring in sub-activity 3.2. Essentially, the assessment will include evaluation of soil conservation practices (both structural and vegetative) towards environmental integrity (allowing moisture infiltration, reducing erosion and nutrient losses). | | |

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| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report on effectiveness of land and soil conservation structures | May |
| 2 | Field layouts and instrumentation completed | Jun |
| 3 | Regional online climatic data analysis from on-farm weather stations available | Aug |

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| **Activity RT4-Gh-4** | Farmer recommendations, tradeoff analysis and scenario generation for land restoration strategies | |
| Lead Scientist(s) | Fred Kizito | Institution: CIAT |
| Other scientist(s) | Wilson Agyare, Francis Tetteh, Emmanuel Panyan | |
| Location (s) | Duko, Samboligo, Bonia, Nangua (Upper East Region) | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT4-Gh-4.1: Economics of farm productivity in the context of soil conservation measures*: | | |
| This will involve: conducting economics of farm productivity that incorporate labor and level of effort for land and soil conservation measures; quantifying losses associated for the lack of action (would use on-farm counter-factual results); and quantify (monetary and non-monetary) the benefits of action associated with interventions. | | |
|  | | |
| *Sub-activity RT4-Gh-4.2: Policy and farmer recommendations, tradeoff analysis and scenario generation* | | |
| This consists of: simple farmer-tailored recommendations that communicate key recommendations; a web-based interface for the research community, policy makers and implementing NGOs on key findings; and overall synthesis for trade-off matrix and scenario generation based on above sub-bullets. Northern Region and Upper East Region to demonstration farms on soil and water conservation in another region of Ghana at the Center for No-Till Agriculture.  This sub-activity will document the biophysical (soil properties and crop yield) and socioeconomic (income and other quality of life indicators) benefits that farmers achieve through soil and water conservation practices. This data collection will provide insight on policies that will further encourage farmer adoption of soil and water conservation practices that can then be further passed on to the Ghanaian government. | | |

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| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Training/exchange visit for lead farmers and agricultural extension agents | Apr |
| 2 | Farmer recommendations for soil and water conservation drafted | Sep |
| 3 | Journal manuscript on tradeoff analysis and scenario generation submitted | Aug |
| 4 | Technical report on progress submitted to donor | Aug |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | Short | Medium | Long |
| 1 | Households are adopting improved water, soil and land management |  | x | x |
| 2 | More households are harvesting water for dry season vegetable production | x | x | x |

|  |  |  |  |
| --- | --- | --- | --- |
| **5. Budget (x U$1000)** | | | |
| Theme/Activity |  | IWMI | CIAT |
| RT4-Gh-1 | Personnel | 20 |  |
|  | Services | 10 |  |
|  | Supplies | 15 |  |
|  | Travel | 5 |  |
|  |  |  |  |
| RT4-Gh-2 | Personnel | 20 |  |
|  | Services | 10 |  |
|  | Supplies | 15 |  |
|  | Travel | 5 |  |
|  |  |  |  |
| RT4-Gh-3 | Personnel |  | 20 |
|  | Services |  | 10 |
|  | Supplies |  | 15 |
|  | Travel |  | 5 |
|  |  |  |  |
| RT4-Gh-4 | Personnel |  | 20 |
|  | Services |  | 10 |
|  | Supplies |  | 15 |
|  | Travel |  | 5 |
|  |  |  |  |
|  | Total | 100 | 100 |
|  |  |  |  |
|  | Grand total |  |  |

**Theme 5: Nutrition, food storage, value addition and mycotoxin management (RT5-Gh)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1. Research team** |  |  |  |  |
| Name | Institution | Degree | Research interest | Role |
| Mahama Saaka | UDS | PhD | Public health nutrition | Leader, RT5-Gh-1 |
| Sofo Mutaru | GHS | MSc | Community nutrition | RT5-Gh-1 |
| Jacob Mahama | GHS | MPh | Public nutrition | RT5-Gh-1 |
| Bridget Parwar | WIAD | MSc | Community nutrition | RT5-Gh-1 |
| Chrisantus Daari | GHS | MSc | Community nutrition | RT5-Gh-1 |
| Gloria Kobati | GHS | MSc | Community nutrition | RT5-Gh-1 |
| Adebayo Abbas | IITA | PhD | Postharvest management | Leader, RT5-Gh-2 |
| Asamoah Larbi | IITA | PhD | Crop-livestock systems | Coordination |
| Ranajit Bandyopadhyay | IITA | PhD | Mycotoxin management | Guidance |
| Abuelgasim Elzein | IITA | PhD | Mycotoxin management | Leader, RT5-Gh-4 |
| George Opit | PHL-IL | PhD | Pest Management | PHL-ILs contact |
| Francis Appiah | KNUST | PhD | Food technology | Leader, RT5-Gh-3 |
| Daniel Agbetiameh | KNUST | MSC | Mycotoxin management | PhD student |
| Richard T. Awuah | KNUST | PhD | Mycotoxin management | RT5-Gh-4 |
| Jojo Baidu Forson | Bioversity | PhD | Agricultural economics | Leader, RT5-Gh-6 |

**2. Objectives**

|  |  |
| --- | --- |
| 1 | Compare the nutritional and health outcomes of focused behavior change communication (BCC) combined with nutrition-sensitive agriculture interventions with only agricultural interventions among children and pregnant mothers. |
| 2 | Conduct training for women groups on positive deviance to improve household nutrition and health of the target groups. |
| 3 | Conduct awareness campaigns to improve knowledge on better household nutrition and the menace of aflatoxin to human health, animal productivity and trade |
| 4 | Improve mothers’ knowledge in nutrition, hygiene and feeding practices. |
| 6 | Determine the nutritional and anti-nutritional characteristics of cereal and legume-based food products as consumed in the target communities |
| 7 | Introduce and test the acceptability of nutritionally enhanced crops and vegetables |
| 8 | Conduct studies on effect of traditional processing methods on nutrient retention and bioavailability |
| 9 | Introduce, evaluate and promote technologies to reduce post-harvest losses in stored cereal and legume grains at the household and community levels |
| 10 | Introduce, evaluate and promote labor saving devices for value additions/processing |
| 11 | Test the efficacy of atoxigenic strains of *Aspergillus flavus* as bio pesticides to reduce aflatoxin levels under farm conditions |
| 12 | Conduct training of trainers workshops on improved soybean and cowpea processing, product development and food hygiene/safety |
| 13 | Build capacity individual (MSc and PhD) and institutional capacity for research on post-harvest losses and value addition |
| 14 | Establish dietary diversity metrics and methods for Africa RISING |

|  |  |  |
| --- | --- | --- |
| **3. Activities** | | |
| **Activity RT5-Gh-1** | Improve household nutrition | |
| Lead Scientists(s) | Mahama Saaka | Institution(s): UDS |
| Other Scientist(s) | Chrisantus Daari, Gloria Kobati, Sofo Mutaru, Bridget Parwar, Mary Paula Kogana | |
| Consultant | To be identified | |
| Location(s) | Intervention communities in the three regions | |
|  | | |
| **Procedures** | | |
|  | | |
| *Sub-activity RT5-Gh-1: Ientify children at risk of malnutrition early enough for counseling and rehabilitation*  Trained Community Health Workers (CHWs) will conduct monthly community based growth monitoring and promotion (GMP) linked with home visits for children aged 6-36 months. GMP provides counseling to the mothers regarding the nutritional status of their children as indicated by the growth chart. The CHW may also do home visits if the child’s growth chart shows no progress or if he/she misses a weighing session. | | |
|  | | |
| *Sub-activity RT50Gh-1.3: Conduct support visits to programme communities* | | |
| Monthly facilitative support visits will be made to growth monitoring and mother support groups meeting sessions by sub-district community health workers. This will provide an opportunity for the supervisors to observe trained CHWs working with mothers/caregivers, compare their performance to standards that are outlined in a supervision checklist, and provide constructive feedback on both the strong points and any difficulties the CHWs have experienced. Supervisors/mentors will then be able to judge the effectiveness of the initial training and provide on-the spot refresher training as needed. Supervision of CHW will be carried out by Community Health Nurses in the sub-districts.  There will also be quarterly review of health and nutrition-related activities at the community level whereby feedback will be given to the workers and stake-holders. | | |
|  | | |
| *Sub-activity RT5-Gh-1.3:* Improve mothers’ knowledge in nutrition, hygiene and feeding practices | | |
| BCC sessions will be held at the community level to improve nutrition and hygiene practices. Cooking demonstration sessions at the community level will be organized to train women on the preparation of appropriate recipes using locally available food types.  Formation/re-activation of mother to mother support groups which should meet monthly in each community to share key messages including the importance of diversifying diets, nutrition during pregnancy, early and exclusive breastfeeding, the appropriate quantity and quality of complementary foods, and preventive healthcare services, such as immunizations, and antenatal care. | | |
|  | | |
| *Sub-activity RT5-Gh-1.4:* Conduct trainings for women groups on positive deviance to improve household nutrition and health of the target groups. | | |
| About 200 pregnant women and nursing mothers with children under 36 months in each region will be trained in positive deviance approach to adopt appropriate nutrition practices. Positive Deviance Hearth Nutrition Model will be applied at household level to disseminate information regarding child feeding practices, promoting the practice of key beneficial maternal & child nutrition messages including the importance of diversifying diets, nutrition during pregnancy, early and exclusive breastfeeding, the appropriate quantity and quality of complementary foods, and preventive healthcare services, such as antenatal care behaviors. Contents of curriculum include group formation, communication skills and monitoring & evaluation. | | |
|  | | |
| *Sub-activity RT5-Gh-1.5: Evaluate strategies for improving household nutrition:* | | |
| Endline evaluation of ongoing community intervention will be carried out in 50 intervention and comparison communities. The assessment will compare the impact of providing BCC messages to individual mothers via peer counselors and providing such messages through Positive Deviance (PD) approach.  The interventions that are being implemented are:   * Legumes, Vegetables and Livestock + BCC delivered through community GMP * Legumes, Vegetables and Livestock + BCC delivered through Positive Deviance (PD) approach.   The comparison communities have received no interventions from IITA. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Coverage and number of community based growth monitoring and promotion (GMP) sessions held | Sep |
| 2 | 800 women trained in positive deviance approach to nutrition delivery | Sep |
| 3 | Inputs and High impact technologies delivered to farm families | Sep |
| 4 | Endline evaluation report on strategies to improve household nutrition | Dec |

|  |  |  |
| --- | --- | --- |
| **Activity RT5-Gh-2** | Reducing postharvest losses in stored grains of cereals and legumes | |
| Lead scientists(s) | Abass Adebayo, Asamoah Larbi | Institution: IITA, ATT |
| Other scientist(s) | Issa Sugri, George Opti, Bekele Kuto, Samuel Obeng-Ofori, , Musa Taylor | |
| Student (s) | To be identified | |
| Location(s) | Tibali, Duko, Tibognayili, Cheyohi (Northern Region); Samboligo, Bonia, Nangua (Upper East Region), Zanko, Guo, Passe, Goli, Nato-Douri (Upper West Region) | |
|  | | |
| **Procedures** | | |
| On-farm trials will be conducted to evaluate, adapt and disseminate storage technologies to reduce post-harvest losses in stored grain, especially maize, groundnut and cowpea.  The activities will be undertaken in collaboration with the Post-harvest Losses Innovation Laboratory, which will provide expertise in entomology, facilitate pilot-testing of a low-cost moisture meter, monitoring aflatoxin levels and research in drying technologies. A letter of intent will be signed with GrainPro to evaluate, adapt and demonstrate some of their products in graduate student’s dissertation research work.  Most of the on-farm studies will use a randomized complete block design (RCBD) with communities as blocks and households as replicates, and farmers’ current practices as controls. The trials will be conducted in 6 communities with 10-20 households per treatment based on the size of the community. The trials will be conducted over 12-18 months. Data to be collected every two months will include: pest infestation, volume per weight loss, quality losses (physical, biochemical, nutritional, economic), aflatoxin levels and farmers’ perceptions. | | |
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| *Sub-activity RT5-Gh-2.1:* Evaluate and demonstrate small-scale machinery | | |
| This activity will be implemented in collaboration with the Agricultural Technology Transfer project. Small-scale, labour-saving machinery (shellers, planters, tillers, fodder choppers) will be evaluated against farmers’ current practice as control. Most of the machinery will be obtained from the ATT project and compared at Africa RISING communities in the three regions with the farming communities. Male and female farmers’ preferences, labor and time saved by the introduced machinery will be recorded. Cost-benefit ratio of using the machinery will be estimated. | | |
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| *Sub-activity RT5-Gh-2.2: On-farm comparison of storage technologies to prevent stored-product insect infestation of maize:* | | |
| Treatments will include:  1. Actellic Super-treated maize in 50kg polyethylene bags (poly sacks)  2. Untreated maize in 50kg polypropylene (PP) bags and  3. Untreated maize in 50kg deltamethrin (DM) incorporated polypropylene VF ZeroFly bags  4. Untreated maize in 50kg Super Grain Bags (GrainPro)  5. Untreated maize in 50kg PICS bags | | |
|  | | |
| *Sub-sub-activity RT5-Gh-2.3: Effect of jute and PIC sacks and grain protectants on maize and cowpea losses on-farm*: | | |
| Treatments:  1. Jute sack  2. PICS bag  3. GS4 sacks  4. Jute sack + protectant  5. PICS bag + protectant  6. GS4 sack + protectant  For each treatment, 50kg of maize and 50kg of cowpea will be stored in jute, PICS and GS4 sacks with or without grain protectants. Two commonly used grain protectants, Actellic Super EC and phostoxin were applied at the recommended rates. Actellic Super EC is a food-grade chemical containing 80g/l pirimiphos-methyl and 15g/l permethrin as emulsifiable concentrate. The application dose provided by the manufacturer is 300ml in 15l of water for 20 maxi bags of maize. Post-harvest losses will be monitored over a period of 12 months. | | |
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| *Sub-sub-activity RT5-Gh-2.4: Evaluate, adapt and disseminate GrainPro products*: | | |
| Sign a letter of intent with GrainPro representative in West Africa to evaluate and demonstrate some of their products. GrainPro will provide the products which will be used for on-farm demonstrations in the Africa RISING intervention communities to compare the new products with farmers’ practices. Potential products to be evaluated include:  1. Super Grain Bags (SGB IV-R)  2. Collapsible Dryer Case  3. Silbags | | |

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| **Activity RT5-Gh-3** | **Biological control of aflatoxins in maize and groundnut with aflasafe GH01** | |
| Lead scientist(s) | Ranajit Bandyopadhyay | Institution: IITA |
| Other scientist(s) | Abuelgasim Elzein | |
| Consultant | Richard Awuah | |
| Student(s) | Daniel Agbetiameh | |
| Location(s) | Tibali, Duko, Tibognayili, Cheyohi, (Northern Region), Nangua, (Upper East Region), Zanko, Guo, Passe, Goli, Nato-Douri (Upper West Region) | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT4-Gh-4.1:* *Intensive laboratory analyses of nearly 1000* samples *collected from the comprehensive field efficacy evaluation trials of Aflasafe GH01 and Aflasafe GH02, conducted across different environments in Ghana in 2015* | | |
| Carry out microbiology analysis (strain isolation, mutant development, complementation) in IITA-Ibadan of the collected soil samples from both treated and control fields before Aflasafe application and three months after harvest, to determine the native population structure of *Aspergillus* in these fields and carryover potential of the atoxigenic strains constituting the two Aflasafe products.  Carry out microbiology (strain isolation, mutant development, complementation) and chemical (aflatoxin extraction and quantification) analyses in IITA-Ibadan to generate efficacy data.for the collected grains samples from both treated and control fields after application, for evaluating field efficacy and recovery atoxigenic strain consituents of the applied products (Aflasafe GH01 & Aflasafe GH02).  These set of efficacy data are a prerequisite for the preparation of a registration dossier and will provide proof and evidence to facilitate registration of the products and future commercialization | | |
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| *Sub-activity RT4-Gh-4.2: Sensitization and training workshops.* | | |
| The scope of public sensitization on aflatoxin and its management through novel biocontrol technology will be continued and broadened. For increasing awareness and enhancing participation on aflatoxin biocontrol activities, three regional (one in each region) sensitization and follow-up meetings will be held for major stakeholders in the maize and groundnut value chains in the new expansion (sites). Major stakeholders for the workshops will include staff from the Ministry of Food and Agriculture (MOFA) at the regional and district levels, farmers, aggregators, millers, poultry farmers, and traders. Besides, partners from regulatory institutions including the Environmental Protection Agency (EPA), Food and Drugs Authority (FDA), and Plant Protection and Regulatory Services Directorate (PPRSD) of MOFA will be invited to the workshops. Further, farmer-oriented international organizations such as SPRING/Ghana and the World Food Programme (WFP) as well as the Ghana Export Promotion Authority (GEPA) will be represented at the workshops. At each workshop, presentations will be made by key resource persons from the IITA biocontrol team, KNUST, MOFA and regulatory authorities. Presentations will highlight aflatoxins as a problem, its causes (how, where and affected crops), signs and symptoms on crops, effects on human and animal health as well as trade, regulations and enforcements, management strategies with focus on biological control, and opportunities for premium markets among others. Participants will be sensitized on the potential of biocontrol for producing maize and groundnut with acceptable levels of aflatoxins giving updates from previous year’s efficacy trials. At each workshop, conscious efforts will be made to link farmers and the market together.  The planned awareness and training activities of this work package will be linked to those led by the PHL-IL. At least nine policy-makers, comprising of 3 regional and 6 district directors of agriculture, will be sensitized. In addition, 500 stakeholders including 400 farmers and at least, 12 AEAs will also be invited to the workshops.  Focus group discussions on the topic will also be held at the community level. In the Northern Region, group discussions will be organized in Duko, and Tibali in the Savelugu District and Tibognayili and Gbanjong in Tolon District. In the Upper West Region group discussions will be organized in Passe and Zanko in Wa West District and Natoduori, Goli and Gyilli in the Nadowli District. While in Upper East Region, group discussions will be organized in Samboligo in Bongo District and Nyangua, Gia and Tekuru in Kassena-Nankana District. A list of all participants in each meeting will be made and leaflets on aflatoxin biocontrol and other management methods will be distributed to participants.  We will also try to coordinate and link this activity with ICRISAT work on aflatoxin management in groundnut in Africa RISING project. | | |
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| *Sub-activity RT4-Gh-4.3: Large-scale field efficacy validation trials for pre-registration of Aflasafe GH01 and Aflasafe GH02 as biopesticides:* | | |
| Following the sensitization and training workshops, farmers and/or farmer associations and sites for on-farm efficacy evaluation of the aflasafe biocontrol agents will be identified and selected from the Africa RISING focus communities. A total of 240 fields will be selected, comprising 60 each treated and untreated (control) maize fields (i.e. 20 fields per region) and 60 treated and untreated (control) groundnut groundnut fields (i.e. 20 fields per region). Field sizes will range between 0.3 ha and 1 ha and separated from control fields by at least 25 m. Each field will be considered a replicate.  Three tons of qualtity Aflasafe products (one and half ton each of Aflasafe GH01 and Aflasafe GH02) will be produced by IITA Aflasafe Manufacturing Plant, in Ibadan in Nigeria, for these large-scale field efficacy validation trials in Northern Ghana.  The trials will be conducted on crops grown by farmers as per their normal agronomic practices. Farmers will be sensitized and trained on application time and method of the aflasafe biocontrol products.  Field soil samples will be collected prior to application of the aflasafe biocontrol products to measure the native population structure of *A. flavus* and after harvesting to measure the changes in the *Aspergillus* community structure due to biocontrol product application. During the 2016/17 project year (from Oct 2016 onwards), sample collection of maize and groundnut grains and soil after application will be carried out for microbial and chemical (aflatoxin) analyses to generate efficacy data. Large data sets will be generated from the extensive analyses of samples collected from the planned comprehensive field efficacy evaluation trials of Aflasafe GH01 and Aflasafe GH02. These field efficacy data will be used for the preparation of dossier to facilitate registration of the Aflasafe products as biopesticides. | | |
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| *Sub-activity RT4-Gh-4.4:* *Carry-over of atoxigenic strains of Aflasafe products from one season to the next and its cumulative impact on aflatoxin reduction 1−3 years after Aflasafe application*. | | |
| In this activity, the frequency of application of Aflasafe GH01 or Aflasafe GH02 over 3 consecutive growing seasons in the Northern Region in farmers’ fields will be continued for the second year in 2016. One hundred and twenty (120) maize fields comprising 60 fields per Aflasafe product selected in the previous year will be used for this trial. These will be sub-divided into 6 treatments of 10 fields each. In treatment 1, fields will be treated in alternate years with Aflasafe GH01 or Aflasafe GH02 within the period of the experiment. In treatment 2, fields will be inoculated consecutively in all three growing seasons. Fields in treatment 3 will be inoculated only in the first and second growing season while in treatment 4 inoculation will be carried out only in the first growing season. Fields in treatment 5 will be inoculated only in the third year while fields in treatment 6 will serve as control with none of the fields inoculated throughout the study period.  Field soil samples and crop (grain) samples will be collected in each growing season for microbial and chemical analyses.  In addition to the 240 fields in the Africa RISING areas in northern Ghana mentioned above (funded by Africa RISING), efficacy trials will also be conducted in the middle belt (funded by another complementary project – the Meridian/PACA/BMGF regional biocontrol development). The country-wide efficacy trials are required to determine the efficacy of biocontrol in several agro-ecozones. | | |
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| *Sub-activity RT5-Gh-4.5:* *Scaling out of Aflasafe technology innovation (expansion) in partnership with the GIZ project in maize value chain and SPRING/Ghana (a USAID funded nutrition project) in Ghana.* | | |
| Partnership was established and meeting was held with the team leader of the Green Innovation Centres for Agriculture and Food Sector – Ghana, a Ghanaian-German programme assisted by the German Government via the Deutsche Geselischaft für Internationale Zusammenarbeit (GIZ), aiming at promoting the use of Aflasafe technologly to reduce aflatoxin contamination in the maize value chain in GIZ project areas. Outcomes of these meetings and contacts are i) Common interest and partnership between IITA and GIZ project was established, ii) Through this partnership, Aflasafe production and dispatch of aflasafe products to small- holder farmers in the Brong Ahafo, Ashanti, Volta and Central regions in Ghana was planned to treat approximately 2500 ha in 2016, and iii) Sensitization and awareness creation workshops, and stakeholder trainings will be conducted on the prevalence of aflatoxin contamination in maize; its health and economic importance to the citizenry; management and the use of aflasafe as a mitigation strategy; and potential opportunities to market grains harvested from aflasafe-treated fields, to increase awareness and enhancing participation on using aflasafe technology for aflatoxin control in maize.    In collaboration with SPRING/Ghana, Aflasafe technology will complement with other activities (initiatives) for improving household nutrition and value addition in northern Ghana. Linkages and contacts have been made with SPRING/Ghana on use (scaling up) of aflasafe in communities of SPRING/Ghana. Common interest and partnership between IITA and SPRING /Ghana project was established. Aflasafe will be introduced in nearly 2,000 ha of groundnut fields for the management of aflatoxin within selected districts in the Northern and Upper East regions in 2016. SPRING/Ghana aims to improving household nutrition in two regions—Northern Region and Upper East Region. Working in 15 districts within these two regions. Unlike the GIZ project, SPRING/Ghana expects IITA to pay for the product. | | |
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| *Sub-activity RT5-Gh-4.6:* *Combined pre- and post- harvest innovations*: | | |
| In partnership with the Feed the Future Reduction in Post-Harvest Losses Innovation Lab, options for minimizing postharvest losses and aflatoxin contamination in maize and groundnut through combining pre-harvest intervention using aflasafe biocontrol and postharvest innovation will be identified and evaluated . The activities will be linked with the **Activity RT5-Gh-2** ‘*Reducing postharvest losses in stored grains of cereals and legumes’* led by Drs Abass Adebayo, and Asamoah Larbi, and will beundertaken in collaboration with the Post-harvest Losses Innovation Laboratory, which will provide expertise in monitoring aflatoxin levels and research in drying technologies. The introduction of drying technologies will give farmers the opportunity to preserve the quality of their commodities by immediately drying grains to the appropriate moisture content. While aflasafe minimizes pre-harvest aflatoxin contamination in maize and groundnut, effective drying with this innovation will help preserve grain quality and further minimize post-harvest crop losses | | |
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| *Sub-activity RT5-Gh-4.7: Inspection of Aflasafe efficacy trials in farmers fields by Environmental Protection Agency (EPA) for its registration in Ghana* | | |
| Active partnership with Ghanaian regulatory authorities such as the EPA and PPRSD of MOFA has been built and will be further strengthened in 2016, to facilitate promotion and registration of the Aflasafe products in the future and strengthen national advocacy coalitions for supporting the process of product registration.  Linkages have been made with EPA who will be involved in monitoring Aflasafe product testing, aiming at promoting benefit of Aflasafe technology with regulators towards registration in Ghana; this is a prerequisite for product registration. A consultation visit and meeting was made and held with the Director of EPA by Dr. Ranajit Bandyopadhyay and Dr. Richard Awuah, to facilitate the inspection and registration process of technology. During this visit in Ghana, we had the opportunity to i) introduce in details Aflasafe biocontrol technology and at the same time receiving EPA technical guidelines and requirements for field efficacy inspection and registration, ii) setup an action plan for the inspection of Aflasafe field efficacy trials in 2016, and iii) obtain permission from the regulatory body EPA to treat 4,000 ha with Aflasafe products in 2016. | | |

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| **4. Expected outcomes** | | 2014 | 2015 | 2016 |
| 1 | Households are adopting behaviors to improve dietary diversity | x | x | x |
| 2 | Caregivers/women apply their nutritional skills in food preparation | x | x | x |
| 3 | Households adapt technologies that reduce post-harvest losses |  | x | x |
| 4 | Extension officers have included aflatoxin management in their messages |  |  | x |
| 5 | Households have adopted measures to reduce aflatoxin in maize and groundnut |  | x |  |

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| **5. Budget (x1000 U$)** | | | | |
| Theme/Activity | Budget Line | IITA | UDS | MOFA |
| RT5-Gh-1 | Personnel |  | 8 | 13 |
|  | Services |  | 4 | 7 |
|  | Supplies |  | 3 | 10 |
|  | Travel |  | 5 | 5 |
|  |  |  |  |  |
| RT5-Gh-2 | Personnel | 28 |  |  |
|  | Services | 14 |  |  |
|  | Supplies | 31 |  |  |
|  | Travel | 7 |  |  |
|  |  |  |  |  |
| RT5-Gh-3 | Personnel | 38 |  |  |
|  | Services | 14 |  |  |
|  | Supplies | 61 |  |  |
|  | Travel | 7 |  |  |
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|  | Total | 190 | 20 | 35 |
|  |  |  |  |  |
|  | Grand total | 245 |  |  |

**3. Mali work plan**

**Theme 1: Partnerships and socio-economics of intensification (RT1-Ma)**

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| **1.** **Research team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Joachim Binam | ICRAF | PhD | Policy | Leader, RT1-Ma-1 |
| Bougouna Sogoba | AMEDD | MSc | Rural development | Deputy leader, RT1-Ma-1 |
| Birhanu Zemadim | ICRISAT | PhD | Land/Water management | Coordination |
| Bekele Kotu | IITA | PhD | Agricultural economics | Leader, RT1-Ma-1.2 |
| Toumani Sidibe | MOBIOM | MSc | Training | Monitor meetings |
| Catherine Dembele | ICRAF | PhD | Agroforestry | Managing trials |
| Ousmane Sanogo | IER | PhD | Farming systems | Market studies |
| Katrien Descheemaeker | WUR | PhD | Farming systems | Farming systems analysis |
| Mary Ollenburger | WUR | MSc | Farming systems | Managing trials |
| Felix Badolo | ICRISAT | PhD | Agricultural economics | Socio-economic studies |
| Mahamadou Dicko | ICRISAT | MSc | Site coordination | Bougouni site coordinator |
| Karamoko Traore | ICRISAT | MSc | Site coordination | Koutiala site coordinator |

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| **2. Objectives** | | | |
| 1 | Promote new demand-driven extension approaches to enhance adoption of technologies by farmers | | |
| 2 | Conduct a stakeholder analysis to analyze existing stakeholders and their interests | | |
| 3 | Strengthen capacity of stakeholders on innovation system approaches | | |
| 4 | Study the role of social networks on innovation systems and their impact on adoption technologies | | |
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| **3. Activities** | | | |
| **Activity RT1-Ma-1** | | Establishment and characterization of R4D platforms | |
| Lead Scientists(s) | | Joachim Binam | Institution: ICRAF |
| Other scientist(s) | | Bougouna Sogoba | |
| Location(s) | | Bougouni and Koutiala Districts | |
|  | | | |
| **Procedures** | | | |
| *Sub-activity RT1-Ma-1.1: Facilitation, Monitoring and evaluation of existing R4D platforms* | | | |
| Monitoring and evaluation data will be collected frequently from the main actors involved in the already existing R4D platforms in Koutiala, Bougouni, M’pessoba and Flola. The M&E tools adapted from FARA (2008) will be used to gather the required data. They will then be analyze to appreciate the effectiveness and efficiency of the platforms. In addition, two more commune-level platforms will be established to support the projected technology parks planned to be set-up in 2016. It will also involve feedback session for the 2016 annual work plan to the platforms in Bougouni and Koutiala. | | | |
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| *Sub-activity RT1-Ma-1.2: Capacity building of partners on stakeholder mapping, engagement and management.* | | | |
| Africa RISING project in Mali is toward the completion of its first phase and is initiating an exit strategy by proposing a second phase implementation programme. Within the first phase, some technologies and practices were trialled and baseline and characterisation studies completed. Some stakeholders were identified but this list is not exhaustive and stakeholders and their relationships were not properly analysed. Stakeholder analysis can help to understand the different perception and interests of stakeholders at different levels, and how they may influence environmental and developmental interactions and outcomes (Grimble and Wellard, 1997). As such, stakeholder mapping and analysis for the coming agenda offers an opportunity to enhance Africa RISING implementation and can:   * Be a first step to improving local governance and institutional capacity building. * Provide a process for interaction with the community and other stakeholders to identify additional sources of information and other resources to support programme implementation. * Determine where stakeholder relationships need to be improved, amended or created. * Identify existing major communication systems for the different groupings within the programme areas. * Promote greater understanding and clarity of the communities’ needs and capabilities. * Identify potential opportunities and threats to the programme interventions including bottlenecks. * At a programmatic level, can identify important scaling partners and policy influencers to be engaged such that policy change and scaling out can be maximised. * Advise on the extent to which certain groups should or could participate in planning, implementation and evaluation of the programme. * Provide information to support learning and consensus building amongst stakeholders. * Identify key and less powerful or marginal stakeholders to engage in decision making.   A technical guide/manual will be developed and finalized and share with different actors as a support tool for another two or three-days 2016 complementary training workshop to the first one planned in 2015 work plan. | | | |
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| *Sub-activity RT1-Ma-1.3: Multi-stakeholder national workshop for feedback on results of the different work packages:* | | | |
| A two-day workshop will be organized in Bamako in April 2016 to present recent findings to partners and adjust plans accordingly to improve integration and synergies. The first day is reserved for presentations, while the second day will allow for adjusting plans, improving integration and identification of synergies. On the first day, the leader or deputy leader of each activity will present the general results; while one to three presentations per activity will allow for detailed information on results and lessons learnt. This will lead to four, short, activity presentations and between four to eight in-depth presentations with discussions. Researchers, local partners and farmers will have stands to demonstrate different available technology options. Local radio, technical services from the region, etc., etc., will be invited.  On the second day, opportunities and constraints arising from the presentations will be identified and work groups will be formed to articulate how these can be dealt with and how we can ensure synergies between activities within a given activity and between activities.  Workshop will particularly include women and youth. | | | |
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| *Sub-activity RT1-Ma-1.4: Establish and assess impact of R4D Platforms on technology adoption:* | | | |
| Methodological and capacity building workshops on R4D platforms and kick-off meetings will be organized for the establishment of platforms linked to the 2016 newly established technology parks. The implementation process will be reviewed and lessons learnt documented. Participatory approaches will be used to monitor and evaluate the activities of the R4D platforms. A one week writeshop will be organized in Koutiala to carry out greater analysis from the existing 250 household level data to ascertain the role of rural social networks and their impact on the adoption of sustainable innovations being promoted within the framework of Africa RISING. 2 publications will be prepared and submitted to peer-reviewed journals by end July 2016. | | | |

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| Deliverables | | Date (2016) |
| 1 | Technical/training guide on stakeholder mapping and analysis | May |
| 2 | Training report on mapping, engagement and analysis | May |
| 3 | Stakeholder maps showing social networks and relationships | August |
| 4 | Guides and protocols on stakeholder analysis, engagement and management | July |
| 5 | One publication to be submitted to peer-reviewed journal on impact of R4D platforms on technology adoption | July |
| 6 | One publication to be submitted to peer-reviewed journal on social networks and power dynamics | July |
| 7 | Socioeconomic and network data uploaded to CKAN | September |

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| **Activity RT1-Ma-2** | Project coordination and facilitation of activities in the technology parks | |
| Lead Scientists(s) | Birhanu Zemadim | Lead Scientists(s) |
| Other scientist(s) | Bougouna Sogoba, Mahamadou Dicko, Karamoko Traore, Cedrick Guedessou and Marc Traore | |
| Graduate student(s) | Mary Ollenburger | |
| Location(s) | Koutiala and Bougouni Districts | |
| **Procedures** | | |
| Mali project coordination is done by ICRISAT in close collaboration with partner institutes. Two technology parks were established in Bougouni (Flola village) and Koutiala (M’Pessoba village). The parks have been used by participating institutes (ICRISAT, ICRAF, AVRDC and IER) to conduct controlled research experiments. Training programs have been conducted in the parks for local NGOs, national training centers and communities living in Africa RISING intervention villages. The parks have been used by other programs, like West Africa sorghum improvement program, groundnut improvement program for capacity building and outreach activities which include men and women and youth. In addition the establishment of the two parks have avoided independent research and capacity building activities by partner institutes. However depending on the scattered nature of community settlements, the two parks were limited to fully reach the communities in the intervention villages. Thus two more parks were proposed during the external evaluation mission commissioned by USAID, one for ech district. The chief scientist of the program for west Africa also proposed better management of the parks through providing a pick-up with driver in each district. The decision on the location of the two new technology parks will be identified in the innovation platform meetings planned for April 2016.  Organize a farmer field day for exchange and co-learning. Exchanges within and between districts is a learning experience for farmers and researchers. Ensure that a diverse group of farmers is represented in capacity building activites (youth and women, different types of farmers e.g. CMDT type A-D) and that their perceptions are captured.  Data: soil moisture, runoff, erosion, agronomic, climate data, socio-economic data (e.g. farmer perceptions of technologies disaggregated by village, sex, age, by farm type). | | |

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| Deliverables | | Date (2016) |
| 1 | Data on improved technologies and participatory research collected and uploaded to the CKAN repository | Dec |
| 2 | Reports on capacity building activities in the technology parks including numbers of participants made available to project partners and shared through the AfricaRISING wiki | Aug |
| 3 | Video documentation of activities implemented in the technology parks | Dec |
| 4 | Report on farmer perception of technologies from the field visit | September |

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| **Activity RT1-Ma-3** | Monitor market prices and characterize value chains | |
| Lead Scientists(s) | Felix Badolo and Ousmane Sanogo | Institution: ICRISAT, IER, AMEDD |
| Other scientist(s) | Oumar Samaké, Birhanu Zemadim, Mahamadou Dicko, Karamoko Traore, and Cedrick Guedessou | |
| Student(s) |  | |
| Location(s) | Koutiala and Bougouni Districts | |
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| **Procedures** | | |
| *Sub-activity RT1-Ma-3.1: Quarterly monitoring of prices of agricultural products in three large, weekly markets in Koutiala and Bougouni:* | | |
| A data collection will be shared with partners for comments and validation. With input from local partners, three major markets will be identified for the study in the Koutiala and Bougouni areas. The validated protocol is then used to survey and monitor market prices on a quarterly basis for a period of two years. Data will be entered and presented in tabular form every 3 months and a synthesis of results and main conclusions are presented in a short report every year from the start of monitoring. This information is used whenever necessary (in the R4D platform meetings, in the country meetings, during feedback sessions and cost-benefit analyses with farmers and for farm system analyses).  Data: market prices of technology components | | |
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| *Sub-activity RT1-Ma-3.2: Value chain studies on at least three value chains identified by the R4D platforms:* | | |
| The R4D platforms at the district level will identify promising value chains on which analyses will be performed. Analyses will be conducted by Felix Badolo, results shared and validated in district level and national level meetings. Value chain studies will include gender analysis.  Production data, market data, data on transformation of products | | |

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| Deliverables | | Date (2016) |
| 1 | Quarterly report on monitoring prices of agricultural products | Aug |
| 2 | Market price data will be uploaded to CKAN | Dec |
| 3 | Technical report on value chain analysis | Aug |
| 4 | Technical report on cost benefit analysis of AfricaRISING technologies | Jul |

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| **Activity RT1-Ma-4** | Economic validation of sustainable intensification options | |
| Lead Scientists(s) | Bekele Kotu, Felix Badolo | Institution: IITA, ICRISAT |
| Other scientist(s) | Ousmane Sanogo |  |
| Location(s) | Koutiala and Bougouni Districts | |
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| **Procedures** | | |
| *Sub-activity RT1-Ma-4.1: Economic validation of improved agricultural technologies.* A number of technologies are being identified in biological trials in Mali. However, socio-economic information about the technologies is lacking. The study aims to evaluate selected technologies from the socio-economic point of view. It will involve: 1) providing socio-economic input to publication of completed studies; 2) collection and analysis of data on on-going trials; and 3) in-depth socio-economic assessment of selected technologies.  *Sub-activity RT1-Ma-4.2: Analysis of the applications of SI practices in West Africa:* Agricultural intensification requires more inputs (such as labor and commercial inputs) per unit of land in order to produce more outputs per unit of land, while its sustainability entails the use of multiple technologies in an integrated manner. Despite this fact, previous studies focused on adoptions of agricultural technologies separately (e.g. improved seeds, fertilizer). This piecemeal approach can only provide a partial answer to sustainable intensification of smallholder agriculture. Therefore, this study aims to examine the adoption of sustainable agricultural practices and technologies in an integrated manner using available Africa RISING baseline data for Mali. A publication wil be developed by lead scientists by December.  Data: agronomic data, socio-demographic data | | |

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| Deliverables | | Date (2016) |
| 1 | Technical report on adoption of technologies in Africa RISING communities in Mali | Dec |
| 2 | Journal article submitted on analysis of early adoption of technologies tested by the AfricaRISING project in Mali | Dec |

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| **4. Expected outcomes** | | Short | Medium | Long |
| 1 | Increased interaction among stakeholders through the R4D platforms | x | x |  |
| 2 | Research institutions use R4D platforms and less of the linear research – extension approach |  | x | x |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **5. Budget (x U$1000)** | | | |  |  |
| Theme/Activity |  | ICRAF | ICRISAT | AMEED | IER |
| RT1-Ma-1 | Personnel | 25 |  | 10 |  |
|  | Services | 0 |  | 5 |  |
|  | Supplies | 6.5 |  | 1 |  |
|  | Travel | 20 | 3 | 4 |  |
|  |  |  |  |  |  |
| RT1-Ma-2 | Personnel |  | 150 |  |  |
|  | Services |  | 30 |  |  |
|  | Supplies |  | 60 |  |  |
|  | Travel |  | 10 |  |  |
|  |  |  |  |  |  |
| RT1-Ma-3 | Personnel |  | 5 |  | 3 |
|  | Services |  | 2 |  | 5 |
|  | Supplies |  |  |  | 1 |
|  | Travel |  | 5 |  | 3 |
|  |  |  |  |  |  |
| RT1-Ma-4 | Personnel |  |  |  |  |
|  | Services |  |  |  |  |
|  | Supplies |  |  |  |  |
|  | Travel |  |  |  |  |
|  |  |  |  |  |  |
|  | Total | 51.5 | 265 | 20 | 12 |
|  |  |  |  |  |  |
|  | Grand total | 348.5 |  |  |  |

**Theme 2: Intensifying cereal-legume-vegetable cropping (RT2-Ma)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Ramadjita Tabo | ICRISAT | PhD | Agronomy | Leader, RT2-Ma-1 |
| Birhanu Zemadim | ICRISAT | PhD | Land and water | Coordination |
| Jean-Baptiste Tignegre | AVRDC | PhD | Vegetable breeding | Leader, RT2-Ma-2 |
| Alpha Sidi Traoré | AVRDC | MSc |  | Managing trials |
| Catherine Dembele | ICRAF | PhD | Agroforestry | Leader, RT2-Ma-3 |
| Fatoumata Traoré | ICRAF | BSc | Leafy vegetables | Monitoring trials |
| Mary Ollenburger | WUR | MSc | Farming systems | Managing trials, |
| Princess Adjei-Frimpong | MSU | MSc | Agronomy | Field implementation |
| Ousmane Sanogo | IER | PhD | Farming systems | Market study |
| Katrien Descheemaeker | WUR | PhD | Farming systems | Farming systems analysis |
| Joachim Binam | ICRAF | PhD | Socio-economy | Economic evaluation |
| Odjouma Samaké | ICRAF | MSc | Agroforestry | Managing trials |
| Bréhima Koné | ICRAF | MSc | Agroforestry | Managing trials |
| Haile Desmae | ICRISAT | PhD | Breeding | Managing trials |
| Dekoro Dembele | ICRISAT | MSc | Breeding | Managing trials |
| Caroline Sobgui | AVRDC | PhD | Nutrition | Leading nutrition activities |
| Moussa Kanoté | AVRDC | MSc | Nutrition | Assisting nutrition studies |

**2. Objectives**

1. Evaluate the impact of participatory varietal testing in combination with improved crop management options on the demand for and sales of agricultural inputs and seeds of improved varieties of a range of crops (vegetables, field crops and tree seeds/seedlings/grafts)
2. Facilitate access to knowledge and information about markets, options, integrated innovations and inputs for sustainable intensification in order to encourage adoption
3. Strengthen the capacities of local stakeholders (farmers, extension and research staff…) in evaluating and testing sustainable innovation options associated with farm system components

|  |  |
| --- | --- |
| 1. Test and evaluate the productivity and profitability of combinations of intensification options (improved varieties, hybrids, fertilizer application, (bio)pesticides, intercropping etc.) at the field scale | |
| 1. Test and evaluate the productivity and profitability of intensified livestock feeding options (stable feeding of small ruminants and dairy cows) | |
| 1. Feedback and discuss results of experimentation with participating farmers in participatory sessions in the villages and to a wider audience through the different platforms | |
|  | |
| 1. Identify and disseminate suitable cultivars or genotypes and efficient cultivation practices for intensive fruit production of *Ziziphus mauritiana*, *Tamarindus indica*, *Adansonia digitata* and *Vitellaria paradoxa.* | |
| 1. Identify efficient cultivation practices for intensive leafy vegetable production from *Moringa oleifera* and *Adansonia digitata* | |
| 1. Identify tree species efficient for improving soil fertility, water conservation and fodder production | |
|  | Assess productivity and profitability of existing mixed cereal/legume-vegetable configurations |
|  | Collect quality data for parameterization of the farm systems components and the whole farm system |
|  | Parameterize models and determine efficiency with different combinations of intensification options |

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| --- | --- | --- |
| **3. Activities** | | |
| **Activity RT2-Ma-1** | Intensifying productivity of cereal-legume cropping systems | |
| Lead Scientist(s) | Ramadjita Tabo | Institution: ICRISAT |
| Other scientist(s) | Haile Desmae, Dekoro Dembele, Birhanu Zemadim | |
| Graduate student(s) | Mary Ollenburger | |
| Location(s) | Koutiala and Bougouni Districts | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT2-Ma-1.1: Data analyses and reporting* | | |
| *Analyze data and develop models based on farm characterization data and cereal-legume experiments conducted in 2013, 2014 and 2015 :* Data will be cleaned and analyzed. Summarized results will be presented in project reports, shared with AR team and presented to farmers and local stakeholders in the AR villages. The effects of different combinations and scenarios of intensification options on farm efficiency, productivity and land use in different scenarios of socio-economic and biophysical developments will be simulated (ex-ante analysis). These results will be published in a peer-reviewed journal (planned: Experimental Agriculture, Contested Agronomy Special Issue to be submitted in June) | | |
|  | | |
| *Sub-activity RT2-Ma-1.2: Organize feedback sessions with stakeholders:* | | |
| Feedback sessions will be organized in the intervention villages to present and discuss the results with local partners and farmers. The feedback sessions will consist of (1) presentation and discussion of agronomic results, and (2) identification of labor requirements for different treatments and cost-benefit analysis of one or more type of trials. Farmer preferred varieties of cereals, grain legumes and vegetables will be identified and plans made to make seeds available for sale through the partners in the R4D platforms. | | |
|  | | |
|  | | |
| *Sub-activity RT2-Ma-1.3: Conducting on-farm participatory variety selection trials and groundnut varieties* demonstrations in Koutiala and Bougouni Districts: | | |
| The objective here is to enhance production and productivity of groundnut in Mali through utilization of improved varieties and production technologies. It is envisaged that over 1000 households will benefit from the planned activities. The program involves implementation of activities in collaboration with local NGOs: AMASSA, CAAD & GRAADECOM. The work involves provision of groundnut seeds and on-farm trials protocols to these NGOs. Training is another component of the work and is provided to local farmers and technical staff of partner institutes on the implementation and management of the on-farm trials. Field trip will also be organized to assess the progress of trials and field days will also be organized by the partners and ICRISAT. Similarly, farm participatory evaluation in field will be conducted to enable farmers select preferred varieties; training on postharvest management and aflatoxin management will be provided and finally qualitative and quantitative data will be collected and analyzed.  Procedure:   1. 5 mother trials and 25 baby trials will be conducted 2. A demonstration plot in the technology Park of M’Pèssoba; 3. Conduct training on good agronomic practices and Aflatoxin management; 4. Conduct post-harvest training; 5. Farmer field days organization | | |
|  | | |
| *Sub-activity RT2-Ma- 1.4: Evaluating different cropping systems and their water use efficiencies in Koutiala and Bougouni Districts* | | |
| Water use efficiency (WUE) is an important determinant of crop productivity in water limited environment. Cereal-legume association have been shown to improve WUE due to differences in rooting pattern of component species resulting in complimentary resource use. Pigeonpea, a semi-perennial legume has the hydraulic lift potential which makes the crop adaptable to highly variable rainfall conditions  However, it is not well established whether pigeonpea is able to hydraulically lift water as a sole crop or as intercrop, and whether this water lifting makes the plant water use efficient. The objective of this work is to determine the soil moisture distribution in the root zone of sorghum and pigeonpea, and assess the effect of cropping system and soil nutrient on sorghum-pigeonpea yields and water use efficiency  Field trials will be established in these two districts in a randomized complete block design with 4 replications, two cultivars of pigeonpea and sorghum. Access tubes will be installed within rows of plots to a depth of 100 cm in some selected treatments. Soil moisture content will be monitored at different stages of plant growth during the growing season. Grain yield and biomass assessment will be taken at the vegetative, flowering and physiological maturity stages of crop growth. Grain yield and soil mosiiture data will be used to quantify which cropping system is water use efficient. | | |

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| Deliverables | | Date (2016) |
| 1 | Bougouni 2015 data on agronomic trials available on CKAN | April |
| 2 | Report on participatory selection of groundnut | December |
| 3 | Report on Water Use Efficiency of cereal-legume associations | Oct |
| 4 | Report on training on groundnut intensification | Aug |
| 5 | Database of PVS 2014-2016 available on CKAN | December |
| 6 | Manuscript on promising technologies (Haile) | Jul |
| 7 | Journal article on Solution Spaces for Sustainable Intensification submitted to Experimental Agriculture | July |

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| **Activity RT2-Ma-2** | Improving productivity and profitability of cereal/legume-vegetable systems | |
| Lead Scientists(s) | Jean-Baptiste Tignegre | Institution: AVRDC |
| Other scientist(s) | Alpha Sidi Traoré, Ousmane Sanogo, Caroline Sobgui, Moussa Kanouté, Felix Badolo | |
| Location(s) | Koutiala and Bougouni districts | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT2-Ma-2.1: Data analysis and publication of results from completed experiments* | | |
| Analyse data from experiments conducted from 2013-2015 and publish results in peer reviewed journals. | | |
|  | | |
| *Sub-activity RT2-Ma-2.2: Disseminate promising technologies conducted over past two years (2014-2015) to intensify vegetable monocropping in cereal-based crop systems in off-season:* | | |
| As this activity requires off-season infrastructure (fencing and well), only those villages with infrastructure will be concerned (Yorobougoula and Sibirila in Bougouni District and Sirakele, Zansoni and Mpessoba in Koutiala District). Participatory testing and diffusion of promising new vegetable cultivars will be carried out to deliver high value, multiple disease-resistant and nutrient-dense vegetable cultivars in the off-season. Vegetable monocropping will implemented with disseminations of farmers’ preferred vegetable varieties and species. Seed production will be initiated to sustain availability in the communities.  Twelve farmers (households) per village in each of five action villages in each of the Bougouni and Koutiala Districts (total of 60) will be selected to participate in testing and diffusion of the four most popular vegetable crops (okra, pepper, tomato and sorrel). In each of the five target actions villages, the vegetable crops chosen will be compared across subsets of 10 households per village (depending on crop preference and seed availability) using two planting densities (farmer practice vs. recommended practice).  Data will be collected on yield, market value and utilization (contribution to dietary diversity) of the tested vegetables. It is intended that this work will form part of the thesis research of an MSc student to be identified. | | |
|  | | |
| *Sub-activity RT2-Ma-2.3: Assess productivity and profitability of promising technologies for an early vegetable production in pure stands:* | | |
| The trial will be conducted in Madina and Dieba (Bougouni District) and Sirakele, Zansoni and Mpessoba (Koutiala District). The best species for early production such as tomato, cabbage, onion, okra and African eggplant will be evaluated. A second year for dry season vegetable early planting trials will continue in 2016 to confirm data collected earlier in 2015 for publication.This will require access to water from wells, rivers, dams and rainwater harvesting and exploring wetland use.  Fifteen farmers (households) per village in each of five action villages, including 50% of women in each of the Bougouni and Koutiala Districts (total of 75) will be selected to participate in testing and diffusion of the four most popular vegetable crops (okra, pepper, tomato and sorrel). In each of the five target actions villages, the vegetable crops chosen will be compared to the local controls in pure stands using AVRDC recommended practices. Data will be collected on yield and market value and utilization (contribution to dietary diversity) of the tested vegetables.  Data: agronomic data on vegetable production trials | | |

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| Deliverables | | Date (2016) |
| 1 | Report on dissemination of vegetable production technologies | Dec |
|  | Report on seed production activities |  |
| 2 | Farmers have been exposed to a variety of legume species in pure stand in 10 villages | Feb (2017) |
| 3 | Report on profitability of dry vegetable production | Sept |
| 4 | Article on intensification of vegetable and maize intercropping systems | December |
|  | Article on intensification of vegetable production in the cold dry season | December |

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| **Activity RT2-Ma-3** | Agroforestry options for intensive fruit, vegetable and fodder production | | |
| Lead Scientists(s) | Catherine Dembele | Institution: ICRAF |  |
| Other scientist(s) | Joachim Binam, Odjouma Samake, Brehima Kone | | |
| Student | Traoré Fatoumata | | |
| Location(s) | Koutiala and Bougouni Districts | | |
|  | | | |
| **Procedure** | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.1: Monitor fruit tree establishment trials established in 2013*, *2014* and *2015 for intensive fruit production:* | | | |
| In August 2013, a trial was established on intensive production of fruits from 7 cultivars of *Ziziphus mauritiana* (Ben Gourrion, Gola, ICRAF6, ICRAF8, ICRAF9, Kaithly, and Umran), 3 superior genotypes of *Tamarindus indica* (Niger 309, Thai sucré, Thai gros fruit), 1 genotype of *Adansonia digitata* (Nonokene) and 1 genotype of *Vitellaria paradoxa* (Samanko-ka). The objective was to determine the effect of manure fertilization and farmer’s choice of irrigation management on the growth and fruit production of 12 cultivars and genotypes from 4 fruit tree species indigenous to the Sahel. Two replicates of 3 grafted plants for each cultivar or genotype were planted in 5 villages retained for the intervention. These are Mpessoba, Sirakele and Zanzoni in Koutiala District and Sibrila in Bougouni District. Plant growth and fruit production will be monitored from 2013 to 2016. Data will be cleaned and analyzed for reporting and publication. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.2: Intensive leafy vegetable production from Adansonia digitata (*baobab*)* and *Moringa oleifera:* | | | |
| Baobab and *Moringa* are two tree species producing high value vegetable for human nutrition. The leaves, rich in calcium and good quality protein, are used green or dried as vegetables everywhere in the Sahel zone in Africa. However, leaves are collected mainly during the rainy season. In order to get fresh leaves year round, intensive method of cultivation is suggested using fertilization and irrigation in each of the 5 target villages. Leaf biomass production monitored from 2014 to 2016 will be will be analyzed for reporting and publishing. This activity will be linked to nutrition (WP-10: sub-activities 5.2 and 5.3) by raising awareness of the nutritional benefits of *Moringa* and baobab and testing ways of using the leaves in a variety of recipes. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.3: Improving soil fertility using fodder and fertilizer tree species:* | | | |
| Four fertilizer and fodder tree species trials (*Acacia angustifolia, Acacia colei, Gliricidia sepium, Calliandra calothyrsus,* and *Piliostigma reticulatum*) established in 2014 and 2015 on farmers’ fields and the technology parks will be monitored. Data collected will be analyzed for reporting. *A. colei, G. sepium and P. reticulatum* will be established along the countour bands that will be established in two technology parks planned for 2016 in collaboration with scientists from AVRDC and ICRISAT. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.4: Monitor improve fruit trees and vegetable trees established within technology park and farmers’ field in 2015.* | | | |
| Within the 2 technology parks, Mpessoba and Flola, superior accessions of *Tamarindus indica*, *Adansonia digitata* and cultivars of *Ziziphus mauritiana* have been established along with vegetable crops in collaboration with AVRDC in the technology parks and in farmers fields. Data obtained will be analyzed and reported. Similar trials on improve fruit trees and vegetable will be established in the two technology parks that will be constructed in 2016 in collaboration with scientists from AVRDC and ICRISAT. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.5: Design household fruit and vegetable tree garden of 30 m2 for enhancing household nutrition.* | | | |
| Volunteer household will be supported to propagate and plants fruit and vegetable trees on small plot (30 m2) for vegetable and fruit production at household level. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.6: Train volunteers for nursery plant propagation by seeds and grafting for private plantation.* | | | |
| Volunteer farmers of the 10 villages will be trained and supported for seedling propagation and grafting in nursery in order to allow them to continue tree planting behind the end of Africa RISING project. | | | |
|  | | | |
| *Sub-activity RT2-Ma-3.7: Survey to assess the opinion of farmers that have been involving in the activities of agroforestry about the different technologies established.* | | | |
| Farmers will be interviewed individually and in group to assess their view point about all agroforestry technologies established: 12 cultivars of 4 fruit species (*A. digitata, T. indica, V. paradoxa and Z. mauritiana*), 2 vegetable tree species (*A. digitata* and M*. oleifera*) planted in fruit and vegetable tree gardens and the technology parks, fodder and fertilizer tree species (*A. angustifolia, A. colei, G. sepium, C. calothyrsus,* and *P. reticulatum*) planted on countour bands. | | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Paper on growth parameters and phenological stages of fruit trees | Oct |
| 2 | Manusript pn growth parameters and leaf biomass of vegetable trees | Oct |
| 3 | Report on biomas production of fertilizer trees | Oct |
| 4 | Survey report | Sep |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | **2014** | **2015** | **2016** |
| 1 | Farmers are adopting improved cereal-legume-vegetable cropping | x | x | x |
| 2 | Farmers are integrating trees and shrubs into their cropping systems |  | x | x |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **5. Budget (x U$1000)** | | | |  |  |  |
| Theme/Activity |  | ICRAF | ICRISAT | AVRDC | CAAD | GRADCOM |
| RT2-Ma-1 | Personnel |  | 5 |  | 3 | 3 |
|  | Services |  | 1 |  | 2 | 2 |
|  | Supplies |  | 1 |  | 1.5 | 1.5 |
|  | Travel |  | 5 |  | 1.5 | 1.5 |
|  |  |  |  |  |  |  |
| RT2-Ma-2 | Personnel |  |  | 40 |  |  |
|  | Services |  |  | 10 |  |  |
|  | Supplies |  |  | 5 |  |  |
|  | Travel |  |  | 5 |  |  |
|  |  |  |  |  |  |  |
| RT2-Ma-3 | Personnel | 20 |  |  |  |  |
|  | Services | 8 |  |  |  |  |
|  | Supplies | 8 |  |  |  |  |
|  | Travel | 14 |  |  |  |  |
|  |  |  |  |  |  |  |
|  | Total | 50 | 12 | 60 | 8 | 8 |
|  |  |  |  |  |  |  |
|  | Grand total | 138 |  |  |  |  |

**Theme 3: Intensive livestock production (RT3-Ma)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Augustine Ayantunde | ILRI | PhD | Animal husbandry | Leader, RT3-Ma-2 |
| Sapna Jarial | ICRISAT | PhD | Crop-livestock | Leader, RT3-Ma-1 |
| Anthony Whitbread | ICRISAT | PhD | Farming systems | Supervision RT3-Ma-1 |
| Ramadjita Tabo | ICRISAT | PhD | Agronomy | Supervision RT-3-Ma-1 |
| Hamidou Natoume | IER | PhD | Animal nutritionist | Field implementation |
| Clarisse Umutoni | ILRI | MSc | Natural Resource Policy | Graduate student |
| Bougouna Sogoba | AMEDD | MSc | Natural resource management | Local partner |
| Intern | ICRISAT | BSc | Agronomy | Graduate student |
|  |  |  |  |  |

|  |  |
| --- | --- |
| **2. Objectives** | |
| 1 | Test options to improve feed from cereal-legume intercropping systems. |
| 2 | Study gender preferences for feeding strategies and technologies. |
| 3 | Demonstrate use of feed choppers. |
| 4. | Study strengths and weakness of local conventions and identify options to strengthen them |
| 5. | Analyze causes of conflicts over natural resource use and options for participatory conflict management |
| 6. | Test feed and health interventions for improved sheep and goat production |

**3. Activities**

|  |  |  |
| --- | --- | --- |
| **Activity RT3-Ma-1** | Improving feed resources production and use in mixed crop-livestock production systems | |
| Lead Scientist(s) | Sapna Jarial | Institution: ICRISAT |
| Other scientist(s) | Ramadjita Tabo, Anthony Whitbread, Hamidou Nantoume, Augustine Ayantude | |
| Graduate students |  | |
| Location(s) | Dieba, Flola and Madina in Bougouni District and M’pessoba, Zansoni, Sirakele and Nampossela in Koutiala District | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT3-Ma-1.1: Train and demonstrate use of a fodder chopper* | | |
| This activity is to create awareness among farmers on the use of a fodder chopper for optimum and efficient use of fresh and dry fodder and analyze profitability of the technology. Members of farmer organizations, including fabricators, feed business persons, NGOs and staff of agriculture and animal husbandry department will be trained in the use of the fodder chopper and the potential business opportunities that it offers. | | |
|  | | |
| *Sub-activity RT3-Ma-1.2:* A national workshop to bring actors on livestock research in Mali. A one day workshop will be conducted in May 2016 to bring actors on livestock program in Mali. The outcome of the workshop help to synthesize livestock research approaches for the second phase of Africa RISING program. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report on crop-livestock trials and fodder chopper technology | Jul |
| 2 | Data on crop-livestock trials uploaded to CKAN | May |
| 3 | Data and report on gender preference to be uploaded on CKAN | May |
| 4 | Report on expert workshop on livestock research | Jun |

|  |  |  |
| --- | --- | --- |
| **Activity RT3-Ma-2** | Document and validation of existing local conventions | |
| Lead scientists(s) | Augustine Ayantunde | Institution: ILRI |
| Graduate student(s) | Clarisse Umutoni |  |
| Location(s) | Koutiala, Bougouni/Yanfolila Districts | |
|  |  | |
| **Procedures** | | |
| *Sub-activity RT3-Ma-2.1.* *Development and formalization of existing local conventions* | | |
| Follow up activities will include: (i) Translation of the local conventions in the 3 communities into local languages (Bambara). (ii) Setting up of monitoring scheme to assess the impact of the newly formalized local conventions on natural resource management in the 3 communities. (iii) Building the capacity of the local surveillance committee through training and exchange visit to Yorosso Commune where the local conventions governing natural resource management were well developed. (iv)Preparation of policy brief on development and formalization of local conventions. (v) Preparation of a video on development processes of local conventions in 3 intervention communities. | | |
|  | | |
| *Sub-activity RT3-Ma-2.2.* *Land use change analysis:* | | |
| To support the development and formalization processes of existing local conventions in the 3 intervention communities, map of land use change analysis will be developed for each community. The land use analysis will compare the changes in land use patterns between 1984 and 2009 using Landsat data. This analysis will provide insight and relevant information on changes in land use patterns in each community which can help to identify rules to be included in the local conventions for access and use of different land use types and ensure sustainable use of the natural resources in the community. As a follow up to the land use change analysis, a workshop will be organized to validate the land use change maps by the kep opinion leaders in the 3 intervention communities (Dieba, Sirakele and Zanzoni). | | |

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| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Translated local conventions in 3 communities in local languages | Jun |
| 2 | Policy brief on development and formalization of local conventions | Jul |
| 3 | Video on local conventions and livestock corridors: tools for peaceful management of natural resources | May |
| 4 | Report of validated land use change maps | Jun |
| 5 | Data on conflict management and transhuamance uploaded to CKAN | July |
| 5 | Draft manuscript on analysis of conflict between farmers and herders in Southern Mali | July |
| 6 | Draft manuscript on farmer perceptions on transhumance practices | May |
|  |  |  |

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| --- | --- | --- |
| **Activity RT3-Ma-3** | Feed and health interventions for improved small ruminant production | |
| Lead Scientist(s) | Augustine Ayantunde | Institution: ILRI |
| Other scientist(s) | Hamidou Nantoume, Bougouna Sogoba | |
| Graduate students | Clarisse Umutoni | |
| Location(s) | Sirakele and Zanzoni (Koutiala district) | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT3-Ma-3.1.: Feed and health interventions for improved small ruminant production in Mali* | | |
| It has been demonstrated that simple interventions involving disease control, improved nutrition and better management lead to marked positive effects on small ruminant performance and productivity. This activity will consist of of feed supplementation and application of health care measures to sheep and goats, and will be compared to the farmers’ practices as a control. The feed supplement will be 300 g concentrate based on locally available agro-industrial products while the health measures will include vaccination against PPR and Pasteurellosis and deworming using Ivermectin. Five farmers each will be selected in each community for the control and the treatment (feed and health interventions) making 20 farmers in total in Sirakele and Zanzoni. The farmers to be selected should have at least 6 sheep and or goats. Data will be collected monthly on animal weight, and births and deaths among the experimental flocks will be monitored. Cost-benefit analyses will be also conducted to assess the profitability of feed and health interventions. In addition farmers will be trained in conservation and improvement of crop residues. Farmers will be selected to include at least 50% women.  Data on live weight changes of sheep and goats for selected farmers, economic data | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 7 | Report on feed-health interventions for improved small ruminant production | January 2017 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | 2014 | 2015 | 2016 |
| 1. | Productivity of sheep and goat improved |  |  | x |
| 2. | More men and women farmers are using food/feed crops as feed |  | x | x |
| 3. | Farmers are using the mobile fodder chopper to improve feeding of livestock |  | x | x |
| 4. | Communities are managing their natural resources without conflict |  | x | x |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **5. Budget (x U$1000)** | | |  |  |  |
| Theme/Activity | | ICRISAT | IER | ILRI | AMEED |
| RT3-Ma-1 | Personnel | 7.5 | 2.5 |  | 2.5 |
|  | Services | 2.5 | 2.5 |  | 0.5 |
|  | Supplies |  | 2 |  | 0.5 |
|  | Travel |  |  |  | 1.5 |
|  |  |  |  |  |  |
| RT3-Ma-2 | Personnel |  |  | 49.56 |  |
|  | Services |  |  | 16.38 |  |
|  | Supplies |  |  | 7.40 |  |
|  | Travel |  |  | 7.47 |  |
| RT3-Ma-3 | Personnel |  |  | 18 |  |
|  | Services |  |  | 12 |  |
|  | Supplies |  |  | 10 |  |
|  | Travel |  |  | 5 |  |
|  |  |  |  |  |  |
|  | Total | 10 | 7 | 125.81 | 5 |
|  |  |  |  |  |  |
|  | Grand total | 147.81 |  |  |  |

**Theme 4: Land, soil and water management (RT4-Ma)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Birhanu Zemadim | ICRISAT | PhD | Watershed Management, | Leader, RT4-Ma-1, 4, 5 |
| Ramadjita Tabo | ICRISAT | PhD | Agronomy | Monitoring |
| Mary Ollenburger | WUR | MSc | Farm systems research | Graduate student |
| Kalifa Traore | IER | PhD | Water and soil | Watershed activities |
| Mahamadou Dicko | ICRISAT | MSc | Technology parks | Coordination |
| Karamoko Traore | ICRISAT | MSc | Technology parks | Coordination |
| Bougouna Sogoba | AMEDD | MSc | Biomass assessments | Contact local partner |
| Katrien Descheemaeker | WUR | PhD | Modeling/farming systems | Modeling intensification |
| Gilbert Dembélé | AMEDD | MSc | Biomass assessments | Technician |
| Cedrick Guedessou | ICRISAT | MSc | Watershed management | Research assistant |
| Marc Traore | ICRISAT | BSc | Organizational | Negotiation |
| Gumma Krishna | ICRISAT | PhD | GIS and RS | Watershed development |

**2. Objectives**

|  |  |
| --- | --- |
| 1 | Determine pasture biomass at the village level and map grazing routes by village herds |
| 2 | Identify and characterize watersheds and their communities for sustainable agricultural intensification |
| 3 | Identify appropriate NRM options and use models to study their impact at different scales |
| 4 | Model intensification and land use at the village level using participatory approaches |
| 5 | Conducting participatory research at defined technology park areas |
| 6 | Integration of multiple research activities at technology park areas to improve institutional engagement |

|  |  |  |
| --- | --- | --- |
| **3. Activities** | | |
| **Activity RT4-Ma-1** | Determine pasture biomass at village-level and map grazing itineraries | |
| Lead Scientists(s) | Birhanu Zemadim | Institution: ICRISAT |
| Other scientist(s) | Gilbert Dembélé, Bougouna Sogoba | |
| Graduate student(s) | Mary Ollenburger | |
| Location(s) | Bougouni District | |
|  | | |
| *Sub-activity RT4-Ma-1.1: Mapping of grazing itineraries* | | |
| In order to complement the assessment of available feed resources at village level, utilization patterns must be established. To this end information on herd composition and grazing itineraries will be collected for 10 village herds in the villages of Sibirila and Dieba. Animal numbers, types, ages, and gestational status will be recorded and movements will be tracked using GPS collars throughout one year to estimate pasture utilization and pressure on grazing resources in different parts of the village territory. This information will help people make informed decisions about use of pasture resources. Thus information from this activity can contribute to reinforcing local conventions.  Data: GPS and time data | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Data from biomass assessment and herd tracking will be uploaded to CKAN | Dec |
| 2 | Manuscript on Ecosystem services from rangelands submitted for publication | Dec |
| 3 | Report on feedback on biomass assessment results through 2015 with farmers | May |

|  |  |  |
| --- | --- | --- |
| **Activity RT4-Ma-2** | Establish and characterize watersheds for integrated research | |
| Lead Scientists(s) | Birhanu Zemadim | Institution: ICRISAT |
| Other scientist(s) | Kalifa Traore (IER), Gumma M Khrishan, Cedrick Guedessou, Marc Traore, Mahamoudu Dicko, and Karamoko Traore, Bougouni Sogoba (AMEDD), Oumar Samaké | |
| Graduate student(s) | Mary Ollenburger | |
| Location(s) | Bougouni and Koutiala District | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT4-Ma-2.1: Establish and characterize two technology parks for integrated research:* | | |
| *Two* technology parks (one in Bougouni District and the other in Koutiala District) will be identified within the Africa RISING action village areas to integrate multiple activities, and to identify major researchable issues that require integration of different research components. It is expected that activities will be worked to produce a common output. In establishing the technology park area several social and biophysical characteristics will be taken into account. For example the willingness of communities to be part of the research program is a priority concern. Thus approval from the local government authorities and local village elders is important. Physiographic characteristics namely presence of elevation, different agronomic practices (rainfed, small scale irrigation systems, land, labor, market will be considered). Two more technology parks are established in the year 2016, each in Bougouni and Koutiala. The criteria used to choose Flola and Mpessoba technology parks in the year 2015 will be valuable for this new sites identification.  In the identified watershed existing data on local farm practices, water uses, traditional land and water management activities and opportunities for improvement are studied. Similarly physiographic characteristics including drainage density, slopes are evaluated. Agro-hydrological characteristics including climatic conditions, land use and land cover pattern and soil nutrients are evaluated. Existing eco-system functions involving benefits that build up from the use an integrated management of natural resources capital are evaluated in the watershed program. Local land and water management interventions at both farm and community (watershed level) are mapped using GPS to characterize the spatial extent of natural resources management in the watershed. This activity generates evidence on the current NRM to support the information needed in sub-activities 4.3 and 5.2. The traditional practices in NRM will be closely aligned with the identification, validation and strengthening of local conventions. The activity is continuous and data is collected in the year 2016. | | |
|  | | |
| *Sub-activity RT4-Ma-2.2: Farmers training on contour bund technology (CBTs):* | | |
| At least two CBT trainings will be organized (one in Koutiala District and one in Bougouni District). Contour Bunding Technology (CBT) has been widely applied in few regions of Mali since 1995 as an effective land and water management intervention. There are existing potentials to further intensify its application which requires training farmers on its use and practices to improve household incomes and conserve the resource capital. At least two CBT trainings will be organized (one in Koutiala and one in Bougouni) in close collaboration with IER and AMEDD. The current activity will be aligned with the social and biophysical characteristics of the R4D platforms developed in Koutiala and Bougouni districts. With the inclusion of two new technology parks and need to engage more farmers in the research program (for scaling), two trainings on CBT will be organized in 2016 for both districts, Bougouni and Koutiala, with the help of AMEDD and IER. The training on CBT is conducted every year to increase awareness among the rural communities on better management of natural resoruces. Every year data will be recorded on the number of CBT adopters. | | |
|  | | |
| *Sub-activity RT4-Ma-2.3: Experimentation on appropriate land and water management technologies:* | | |
| Contour Bunding Technology (CBT) has been widely promoted as a sustainable land and water management technology in Mali. Benefits including runoff control and prevention of soil erosion and extension of crops growing period were the main targets of the CBT applications. However since its application there are limited research activities to understand its impact on water runoff, erosion, crop productivity and ecosystem services. Data collected from the two technology parks in 2015 revealed that there is a reduction of surface runoff by 60% in farm fields treated with CBT. Therefore it is planned to do more experiment on the CBT technology in few Africa RISING villages and integrate other programs for example the farm/field level intensification options. The experimentation will be done in the identified watershed where part of the watershed area will be treated for CBT and part of the area is reserved for control. In the treatment and control portions various crop intensification options for example levels of fertilizer/manure applications, crop varieties, treatments and management options will be studied to understand the changes in crop yield, biomass and fodder productivity and the gains in eco-system services. Similarly monitoring stations (runoff, soil moisture, sediment, ground water level) will be established in both control and treatment and the changes in biophysical and eco-system conditions will be monitored in close collaboration with local communities. Here communities will be trained in participatory monitoring skills. Hence output of the CBT practices will be experimented through biophysical monitoring and crop productivity. Monitored data in terms of changes in water level in identified boreholes and streams outlet locations, soil moisture status, erosion and sedimentation rates provide biophysical impacts of CBT interventions in the watershed. Similarly crop yield, biomass, regeneration of vegetation will be monitored both at control and treated watershed to quantify the impact of intervention. Spatial data will be mapped using GIS and data analysis help to characterize the *in situ* water use efficiencies, land degradations and intensification options for crop productivity status from farm to small watershed scale. Similarly, the various crop intensification options under technologies of land and water management will support the development of scenarios for modeling. The activity will look in to efficiency of farm systems under various intensification options. The activity started in 2015 agricultural season and need to continue for 2016. Improved data quality is expected from the 2016 agricultural season to make reliable statistical analyses. Practically farm fields will be divided in two parts and four set of equipment for runoff and erosion measurement will be installed. In the first part ridges will follow the contour lines referred to contour bunding (CB) when in the second neighboring plot traditional farmer practices (NCB) will be implemented as a control. Two replications will be implemented in the contour lines plot and two other in the control. The two parts will be homogeneously managed concerning all field operations and crop species. Data will be collected during each rainfall event generating runoff.   * Soil and water samples will be taken and send to the IER Soil-Water-Plant laboratory for assessment of sediment and nutrient eroded. * Soil moisture using TDR probe will be performed in each of the CB and NCB plot to follow up water vertical distribution according to management practies in Flola and M’Pessoba. * Water table measurement will be performed and two more measurements points will be installed for data accuracy and representativeness. * Continuation of soil study (pedology, toposéquence description etc.) through the works of graduate students will continue. | | |
|  | | |
| *Sub-activity RT4-Ma-2.4: Modeling from field to watershed level using biophysical model:* | | |
| Various farm to small scale watershed intervention outputs will be combined to develop appropriate natural resources management practices. Information obtained from the baseline reports, field investigations and experimental analysis will be modeled using the Soil and Water Assessment Tool (SWAT) model. Apart from evaluating the farm level biophysical gains due to improved soil and water management practices, the model simulates the Blue and Green Water and help to simulate the gains in biophysical settings due to intervention options on land and water management practices. The model also simulates crop productivity under various land and water management options. Monitored data from the watershed will be used to calibrate and validate the model. The validated model will be used to develop various scenarios that help to intensify the farm/watershed scale intervention of land and water management. Hence impacts of land and water management practices will be established at a scale which is appropriate to intensify agricultural productivity in the study region. Data collected in the year 2015 has been useful to set-up the model. However biophysical data collection need to continue for the year 2016 to have a reliable dataset that would help to validate the model. | | |
|  | | |

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| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Paper on prioritization of water sheds using remote sensing and GIS published | Dec |
| 2 | Paper on socio-economic characterization of Africa RISING sites submitted | Nov |
| 3 | Paper on shallow wells the untapped resources for food security published | July |
|  |  |  |
| 5 | Report on experimental results on improved land and water management | Dec |
| 6 | 2015 database on soil moisture, rainfall, runoff and sediment yied uploaded on CKAN | May |
| 7 | 2016 database on soil moisture, rainfall, runoff and sediment yied uploaded on CKAN | Dec |

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| --- | --- | --- |
|  | | |
| **Activity RT4-Ma-3** | Model development pathways and land use at village level | |
| Lead Scientists(s) | Birhanu Zemadim | Institution: ICRISAT |
| Other scientist(s) | Katrien Descheemaeker |  |
| Graduate student(s) | Mary Ollenburger |  |
| Location(s) | Bougouni District –Sibirila and Dieba villages | |
|  |  | |
| **Procedures** | | |
| In Sikasso Region there are strong interactions both among farms and between farms and the surrounding non-cropped areas. Therefore it is important to integrate farm-scale intensification and larger-scale land use and natural resource management, to assess potential impacts of technologies and institutions. Agent based models can integrate biophysical and social system components and serve as tools for informing discussion of scenarios for system change. Summary models of farm system components and processes in non-cropped areas will be based on results from field trials, farm characterization (WUR situation analysis), and biomass assessment grazing itineraries. Scenarios for possible futures will be developed in workshops with farmers and key stakeholders. Technology options as well as institutional innovations will be explored under these scenarios. This will allow us to explore possible effects of integrating farm-scale technologies with scenarios involving strengthened local conventions and improved management of natural resources at larger scales. Participatory modeling approaches will be used to explore ways to minimize trade-offs between improving farm production and farmer livelihoods and conserving natural resources.Workshops will be held in Sibirila and Dieba prior to the 2016 growing season to jointly create scenarios for modeling. Results of modeling will be presented at workshops in the same villages in September and reported to platforms. | | |

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| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report on workshops for generating scenarios with farmers | May |
| 2 | Report on workshops for reporting scenario modeling | September |

|  |  |  |
| --- | --- | --- |
| **Activity RT4-Ma-4** | Mapping landuse/landcover (LULC) and temporal changes in LULC-dynamics | |
| Lead Scientists(s) | Gumma Murali Krishna | Institution: ICRISAT |
| Other Scientist(s) | Birhanu Zemadim | |
| Location(s) | Sikasso Region | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT4-Ma-4.1: LULC mapping and quantify changes temporally:* | | |
| Landuse and landcover mapping using LANDSAT 8, 16 day repeat imagery along with MODIS @ 250mts 8 day composites. With extensive ground information and advanced classification techniques, accurate LULC maps can be generated for the Sikasso Region. | | |
|  | | |
| *Sub-activity RT4-Ma-4.2: Impact of adoption of NRM technologies:* | | |
| Adoption of NRM technologies suitable for the location triggers changes in the biophysical environment which may be positive or negative. The impact of these technologies will at the same time, facilitate the targeted objectives. Remote sensing and GIS tools can be used to quantify the impact of adoption of these technologies. | | |
|  | | |
| *Sub-activity RT4-Ma-4.3: Biomass estimation using Normalized Difference Vegetation Index (NDVI):* | | |
| Biomass will be estimated using multi-spectral data from LANDSAT 8 and MODIS imagery. Biomass sampling will be carried out on the selected fields during the crop season. | | |
| Sub-activity RT4-Ma-4.4: Water shed prioritization for agriculture development: | | |
| Prioritization of watersheds involves selection of appropriate spatial data leyers relavent to agriculture development, development of criteria based on the importance of selected layers, delineating watersheds using elevation data, selection of high priority watersheds. | | |
|  | | |
| Sub-activity RT4-Ma-4.5: Assessing impact of upstream interventions in downstream watersheds: | | |
| Assessing land use/ land cover changes in downstream watersheds using satellite imagery temporally due to upstream interventions. | | |
|  | | |
| Sub-activity RT4-Ma-4.6: Groundwater potential zones for water resources management: | | |
| Delineating groundwater potential zones using relavent spatial data layers derived from primary data and satellite imagery. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report on delineated groundwater potential zones | Dec |
| 2 | Report on Assessment of impact of upstream interventions in downstream watersheds | Dec |
|  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | **2014** | **2015** | **2016** |
| 1 | Farmers are adopting improved technologies to improve traditional farming | x | x | x |
| 2 | Communities are managing their natural resources without conflict |  | x | x |
| 3 | Scientists are validating and adapting the models developed |  | x | x |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5. Budget (x U$1000)** | | |  |  |
| Theme/Activity |  | ICRISAT | IER | AMEED |
| RT4-Ma-1 | Personnel |  |  |  |
|  | Services |  |  |  |
|  | Supplies |  |  |  |
|  | Travel | 1.5 |  |  |
|  |  |  |  |  |
| RT4-Ma-2 | Personnel | 30 | 10 | 15 |
|  | Services | 9 | 10 | 7.5 |
|  | Supplies | 10 | 10 | 7.5 |
|  | Travel | 8.02 | 10 | 10 |
|  |  |  |  |  |
| RT4-Ma-3 | Personnel |  |  |  |
|  | Services |  |  |  |
|  | Supplies | 0.19 |  |  |
|  | Travel | 13.83 |  |  |
|  |  |  |  |  |
| RT4-Ma-4 | Personnel | 10 |  |  |
|  | Services | 2 |  |  |
|  | Supplies | 1.5 |  |  |
|  | Travel | 2.48 |  |  |
|  |  |  |  |  |
|  | Total | 88.52 | 40 | 40 |
|  |  |  |  |  |
|  | Grand total | 168.52 |  |  |

**Theme 5: Nutrition, food storage, value addition and mycotoxin management (RT5-Ma)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Caroline Makamto Sobgui | AVRDC | PhD | Public health/nutrition | Leader, RT5-Ma-1,2 |
| Toure Fatimata Maiga | IER | BSc | Technology transfer | RT5-Ma-2 |
| Honafing Diarra | AVRDC | BSc | Nutrition | RT5-Ma-1 |
| Pierre Coulibaly | AMEDD | BSc | Animal nutrition | RT5-Ma-1, 2 |
| Aliou Coulibaly | IER | BSc | Food processing | RT5-Ma-2 |
| Fatimata Cissé Diallo | IER | PhD | Food processing | RT5-Ma-1,2 |
| Diabate Morimousso Doumbia | IER | BSc | Technology transfer | RT5-Ma-2 |
| Salimata Sidibé Coulibaly | IER | PhD | Food processing | Leader, RT5-Ma-1,2 |
| Yara Dembele Koureissi | IER | PhD | Nutrition | RT5-Ma-2 |
| Awa Konaté | AVRDC | BSc | Nutrition | RT5-Ma-1 |

|  |  |
| --- | --- |
| **2. Objectives** | |
| 1 | Improve women’s nutrition knowledge through nutrition field schools. |
| 2 | Evaluate options for improving the dietary diversity of households. |
| 3 | Evaluate post-harvest storage technologies. |

|  |  |  |
| --- | --- | --- |
| **3. Activities** | | |
| **Activity RT5-Ma-1** | Evaluate strategies for improving household nutritional diversity in Mali | |
| Lead Scientists(s) | Caroline Makamto Sobgui | AVRDC, IER |
| Other scientist (s) | Honafing Diarra, Fatimata Diallo Cissé, Pierre Coulibaly, Salimata Sidibé, Awa Konaté, Fatimata Cissé Diallo | |
| Location(s) | Koutiala District | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT5-Ma-1.1: Improving nutritional knowledge of community and extension workers:* | | |
| Community volunteers, agriculture and health and nutrition workers in the intervention communities will be trained in ‘Behaviour Change Communication’ (BCC) in nutrition and health. This will equip community workers with the technical, action-oriented knowledge and counseling skills needed to support pregnant women, breast-feeding mothers with children under two years of age and other key family members to adopt nutrition practices. Refresher training to [recall](http://www.businessdictionary.com/definition/recall.html) and reinforce of previously [acquired knowledge](http://www.businessdictionary.com/definition/acquired-knowledge.html) and [skills](http://www.businessdictionary.com/definition/skill.html) will be organized every six months. | | |
|  | | |
| *Sub-activity RT5-Ma-1.2: Evaluate strategies for improving household nutritional diversity:* | | |
| Activities and data collection to evaluate strategies for improving household nutrition security started in 2015 will continue in Koutiala while they will be initiated in Bougouni district where nutrition activities were not previously implemented.  In Koutiala district, two hundred households with women of child bearing age and nursing mothers with children aged 6-24 months randomly selected in 2015 from intervention communities will continue to be followed to assess the impact of providing community nutrition trainings on adoption of improved nutrition practices for young children. At least 100 households have been randomly assigned to one of the following treatments:  1. Behavior change communication training on nutrition and agriculture support in vegetables, legumes and cereals.  2. Agriculture support in vegetables, legumes and cereals.  Extension workers will conduct monthly Behavior Change Communication sessions in target communities on improved nutrition practices and home visits to counsel and support mothers and their families This will be linked with Activity RT5-Ma-2 on improving post-harvest and processing techniques.  The approach used to select beneficiaries allows to identify two groups of beneficiaries’ notably primary beneficiaries who serve as Mother light and secondary beneficiaries. Primary beneficiaries are those women who are trained by project staff and will receive seed kits; they will agree, in their turn, to transfer the acquired knowledge to the secondary beneficiaries who will also receive seed kits.This aimed to equip women of child bearing age and specially lactating mothers with children below aged 6-24 months and pregnant women with knowledge and skills to foster adoption of proper health care and nutritional practices.  Women will be organized in nutrition support groups which gather twice each month at the village level to discuss their experiences and learn better practices in child care, feeding, health, sanitation, gardening and small livestock raising.  Nutrition Club meetings will be facilitated by a trained community worker. The establishement of nutrition support groups will be facilitated by the project team by providing essential cooking materials.  Separate sensitization meeting with community leaders, fathers and grandmothers will be conducted every two months to foster community mobilization and create and strengthen an enabling and supportive environment for behavior change. Data on young child nutrition practices including initiation of complementary feeding, breatfeeding practices, dietary diversity scores, frequency of feeding, type of foods/fluids, hygiene practices and responsive feeding practices will be collected every three months to monitor behavior change and adoption of good practices  A cluster non-randomized controlled trial will be used to collect quantitative and qualitative data on dietary diversity score, Knowledge, attitude and practices primary data from mother/child pairs. This means **a controlled** pre-test/post-test design involving two cross-sectional surveys at baseline and end point follow-up will be used to determine the outcome/impact of the program. **This will involve making** observations before and after the implementation of the intervention.  Comparison of selected indicators at baseline and at end of project will give an indication of changes that have taken place with time. Additionally, a comparison between intervention and control communities will show the changes which can be attributed to the program interventions. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Report on dietary diversity of households in the intervention areas | Aug |
| 2 | Report or publication on the number of people trained in improved nutrition practices and the number of nutrition support groups established and functional | Aug |
| 3 | Reporting of about 200 farmers trained in intensive vegetable post-harvest management and nutrition techniques | Sept |
| 4 | Manuscript on strategies to improve nutrition practices in Southern Mali will be prepared and submitted for publication in a peer-reviewed journal | December |
| 5 | Gender-disaggregated data on nutrition status, knowledge attitudes and practices uploaded to CKAN | December |

|  |  |  |
| --- | --- | --- |
| **Activity RT5-Ma-2** | Evaluate postharvest technologies | |
| Lead Scientists(s) | Salimata Sidibé Coulibaly | Institute: IER, AVRDC |
| Other scientist (s) | Fatimata Diallo Cisse, Yara Dembele Koureissi, Aliou Coulibaly, Diabate Morimousso Doumbia, Toure Fatimata Maiga, Caroline Makamto Sobgui, Eva Weltzien | |
| Location(s) | Koutiala and Bougouni districts | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT5-Ma-2.1*  Develop improved processing, preservation techniques using crops, legumes, vegetables and animal products by adding value to them. Develop complementary feeding, diversified diet for children under 24 months and women in child bearing age, as well as wide consumption products. These products will be developed based on the available local products and equipment’s.  This activity will continue on the development of improved processing and preservation techniques using animal products.  There will be 6 treatments and 3 controls   * T1 = Malted maize flour couscous * T2 = Malted maize flour couscous + leafy vegetables (moringa, spinach, etc….) * C1 = Normal maize flour couscous * T3 = Malted sorghum flour couscous * T4 = Malted sorghum flour couscous + leafy vegetables (moringa, spinach, etc….) * C2 = Normal sorghum flour couscous * T5 = Malted millet flour couscous * T6 = Malted millet flour couscous + leafy vegetables (moringa, spinach, etc….) * C2 = Normal millet flour couscous * Proximate composition (protein, lipids and energy contents) of the developed products will be determined as well as Iron, Zinc, vitamin A, and Calcium. Sensory characteristics and acceptability tests will be conducted in lab and field (household). * Evaluate the shelf life, storage conditions and quality of the developed products. The developed products will be stored in two different storage conditions as in the villages and in packages to add value to the products. Determine the rancidity of the developed products during the shelf life period.   *Sub-activity RT5-Ma-2.2*  Train women, mothers and caregivers on the developed processing preservation, and value addition techniques. The developed processing and preservation techniques will be transferred to the target group by training sessions in the Nutritional and Production Field Schools in Koutiala and Bougouni Districts. Training modules will be developed for the local trainers. Knowledge and practices of dietary diversity will be included in the training modules.  *Sub-activity RT5-Ma-2.3*  Monitor the consumption and utilization of the developed products and techniques. Monitoring of the consumption and use of the developed products will be conducted every 3 months using elaborated monitoring documents to assess the degree of utilization of the developed processing techniques. The monitoring documents will be given to local trainers in Nutritional Field Schools (NFS) Production Field Schools (PFS) in order to evaluate the consumption frequencies, the number of families practicing and using the developed techniques, and their utilization modes (familial and local consumption as well as sales).  *Sub-activity RT5-Ma-2.4*  The experiment will evaluate the effect of the new complementary feeding mix on the nutritional status of children from 9 – 24 months. There will be 3 groups (1 control group and 2 treatment groups: 15 children in each group). The complementary feeding mix will be made and packaged at LTA. | | |

|  |  |  |
| --- | --- | --- |
| Deliverables | | Date (2016) |
| 1 | Manual on postharvest technologies modules and report on:  Number of modules,  Number of training sessions,  Number of beneficiairies, disaggregated by gender | June |
| 2 | Report on monitoring of nutrition activities, documents elaborated  Number of monitoring visits and beneficiaries adopting the technologies disaggregated by gender | September |
|  |  |  |
| 4 | Data on physical, nutritional and sensory characteristics of developed products uploaded to CKAN | December |
| 5 | Article on malting and fermentation to improve viscosity and energy density of complementary feeding submitted | December |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4. Expected outcomes** | | | | | | | | **2014** | **2015** | **2016** |
| 1 | Women are putting into practice knowledge from nutrition field schools | | | | | | | x | x | x |
| 2 | Households are adopting behaviors that improve their nutritional status | | | | | | |  | x | x |
| 3 | Households are adopting options to reduce post-harvest losses | | | | | | |  | x | x |
| **5. Budget (x U$1000)** | | | |  |  |  |
| Theme/Activity | | | ICRISAT | IER | AMEED | AVRDC |
| RT5-Ma-1 | | Personnel |  | 5 | 6 | 30 |
|  | | Services |  | 0.5 | 6 | 10 |
|  | | Supplies |  | 0.5 | 4 | 5 |
|  | | Travel | 1 | 4 | 4 | 10 |
|  | |  |  |  |  |  |
| RT5-Ma-2 | | Personnel |  | 10 |  | 1.5 |
|  | | Services |  | 5 |  | 1 |
|  | | Supplies |  | 5 |  | 1 |
|  | | Travel | 1 | 10 |  | 1.5 |
|  | |  |  |  |  |  |
|  | | Total | 2 | 40 | 20 | 60 |
|  | |  |  |  |  |  |
|  | | Grand total | 122 |  |  |  |

1. The vegetables will be selected in consultation with farmers, IITA, AVRDC and NGO working in the area. [↑](#footnote-ref-1)